

THE
Tea Research Institute
OF
Ceylon

BULLETIN No. 29

Annual Report for the Year
1947



Published by

THE TEA RESEARCH INSTITUTE OF CEYLON,
ST. COOMBS, TALAWAKELLE.

The Tea Research Institute of Ceylon

SCIENTIFIC STAFF

Director

... Roland V. Norris, D.Sc. (Lond.),
M.Sc. (Manc.), F.R.I.C.

Department of Plant Pathology.

Pathologist and Deputy Director	...	C. H. Gadd, D.Sc. (Birm.)
Mycologist	...	D. R. Kemp, B.Sc. (Lond.)
Assistant Entomologist	...	G. D. Austin
Research Assistant	...	C. A. Loos
Assistants	...	D. J. W. Ranaweera
		W. T. Fonseka
		S. N. VanderWal

Department of Agricultural Chemistry.

Agricultural Chemist	...	T. Eden, D.Sc. (Manc.), A.R.I.C.
Assistant	...	E. N. Perera
Field Assistants	...	M. Piyasena
		F. P. Jayawardana

Department of Biochemistry.

Biochemist	...	J. Lamb, M.Sc. (Lond.), A.R.I.C., A.I.C.T.A.
Research Assistant	...	M. S. Ramaswamy, B.Sc. (Mysore), A.I.I.Sc.
Assistants	...	E. L. Keegel
		V. Mendis
		S. M. Guneratnam

Department of Plant Physiology.

Plant Physiologist	...	(Vacant)
Assistant	...	E. S. Rajlah
Field Assistant	...	F. H. Kehl

Small-Holdings Officers.

R. L. Illankoon
F. D. Tillekeratne

Superintendent, St. Coombs Estate ... F. C. Daniel

NOTE

The Laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and letters and enquiries should be addressed to the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle. Telegraphic Address.—Research, Talawakelle, Telephone, Talawakelle 44 (Private Exchange). It is particularly requested that letters should not be addressed to officers by name.

TWENTY-SECOND ANNUAL REPORT

OF THE
BOARD OF THE TEA RESEARCH
INSTITUTE OF CEYLON
FOR 1947

Foundation.—The Tea Research Institute was established by Ordinance No. 12 of 1925, dated the 27th October 1925. The Constitution of the Board is laid down in the Ordinance; the personnel on the 1st day of January, 1947, was :—

Ex-Officio Members.

The Hon'ble the Financial Secretary (Hon'ble Sir Oliver Goonetilleke, K.B.E., C.M.G.)

The Director of Agriculture (Mr. L. J. de S. Seneviratne, C.C.S.)

The Chairman, Planters' Association of Ceylon (Mr. R. Singleton Salmon)

The Chairman, Ceylon Estates Proprietary Association (Mr. C. A. Meakin).

Representatives of the Planters' Association of Ceylon.

Mr. H. S. Hurst.

Mr. H. de T. Wilkinson Kay.

Mr. E. G. Groves (Acting for Mr. R. C. Scott, C.B.E. on leave).

Representatives of the Ceylon Estates Proprietary Association.

Mr. J. C. Kelly.

Mr. W. H. Attfield.

Mr. F. A. Bond (Acting for Mr. D. T. Richards on leave).

Representative of the Low-Country Products Association.

Mr. F. Amarasuriya.

Representative of the Small-Holders.

Mr. S. Vytilingam, M.S.C.

Chairman.—Mr. R. C. Scott, C.B.E, (Mr. R. Singleton Salmon Acting).

Secretary.—Dr. Roland V. Norris.

Solicitors.—Messrs. Julius & Creasy.

Auditors.—Messrs Ford, Rhodes, Thornton & Co.

Registered Office.—Office of the Planters' Association of Ceylon, Kandy (later Colombo).

The following changes in the composition of the Board took place during the year :—

Mr. J. C. Kelly proceeded on leave on 1st February, 1947 and Mr. W. H. Gourlay was nominated by the Ceylon Estates Proprietary Association, to act for him.

Mr. R. C. Scott resumed his seat on the Board on his return from leave on 20th March, 1947 and relieved Mr. R. Singleton Salmon of the Chairmanship.

Mr. F. A. Bond proceeded on leave and Mr. G. K. Newton was nominated by the Ceylon Estates Proprietary Association to act for him, with effect from 10th April, 1947.

Mr. H. de T. Wilkinson Kay resigned as from 1st May, 1947 and Mr. W. W. A. Phillips was nominated by the Planters' Association to take his place.

Mr. W. A. Paterson became an *ex-officio* member of the Board as Chairman of the Planters' Association of Ceylon with effect from 21st August, 1947, *vice* Mr. R. Singleton Salmon resigned.

Mr. D. F. Ewen became an *ex-officio* member of the Board on his assuming the Chairmanship of the Agency Section of the Planters' Association of Ceylon, *vice* Mr. C. A. Meakin.

Mr. C. E. Jones C.M.G., C.C.S., Secretary to the Treasury, was nominated to serve as an *ex-officio* member of the Board as representative of the Minister for Finance with effect from 23rd October, 1947.

Mr. J. C. Kelly resumed his seat on the Board on his return from leave on 24th October, 1947, and relieved Mr. W. H. Gourlay who was acting for him.

Mr. D. Rhind on his appointment as Director of Agriculture replaced the former Acting Director, Mr. L. J. de S. Seneviratne, C.C.S.

COMMITTEES.

Finance Sub-Committee.—The Chairman, Planters' Association of Ceylon, (Mr. R. Singleton Salmon), the Chairman, Ceylon Estates Proprietary Association (Mr. C. A. Meakin), Messrs. W. H. Attfield, H. S. Hurst, J. C. Kelly, F. A. Bond (Acting for Mr. R. C. Scott on leave) and the Director, Tea Research Institute.

Mr. W. H. Gourlay acted for Mr. J. C. Kelly during the latter's absence on leave.

Mr. R. C. Scott on his return from leave relieved Mr. F. A. Bond who was acting for him.

Mr. W. A. Paterson took the place of Mr. R. Singleton Salmon when he was appointed Chairman of the Planters' Association of Ceylon.

Mr. C. A. Meakin was succeeded by Mr. D. F. Ewen on the latter's appointment as Chairman of the Agency Section of the Planters' Association of Ceylon.

The Committee held three meetings during the year,

Experimental Sub-Committee.—The Director, Tea Research Institute (Chairman), the Acting Chairman of the Board of the Tea Research Institute of Ceylon (Mr. R. Singleton Salmon), the Visiting Agent (Mr. A. H. Hall), the Superintendent, St. Coombs Estate (Mr. F. C. Daniel), Messrs. H. S. Hurst, P. B. Cruickshank, F. A. Bond, E. de la Mare, T. Kane, G. K. Newton and S. Bolster.

Mr. R. C. Scott, C.B.E., on his return from leave replaced Mr. S. Bolster who was acting for him.

Mr. E. G. Groves was appointed to take Mr. F. A. Bond's place when the latter proceeded on leave.

Mr. R. H. Horne replaced Mr. T. Kane on his return from leave.

Three meetings of the Committee were held.

Medical Scheme Sub-Committee.—The Chairman, Tea Research Institute of Ceylon, the Director, Tea Research Institute of Ceylon, and Mr. G. D. Austin (representing the Junior Staff).

Trustees of the Junior Staff Provident Fund.—The Chairman, Tea Research Institute of Ceylon, the Director, Tea Research Institute of Ceylon, Mr. J. C. Kelly, and Mr. E. N. Perera (representing the Junior Staff).

Visiting Agent.—Mr. A. H. Hall continued as Visiting Agent to St. Coombs and his services were much appreciated by the Board.

FINANCE.

The total receipts for the year were Rs. 588,406, an increase of Rs. 123,166, comprising Research Cess Rs. 402,130, Profit on St. Coombs Estate Rs. 175,764, and Interest and Miscellaneous Receipts of Rs. 10,512. The figure for the cess was Rs. 6,301 below that for 1946 but the profit on St. Coombs was increased by no less than Rs. 128,968, this being due in the first place to the high crop figure 262,132 lbs. and to the higher selling price obtained, 170.86 cents nett as against 126.97 cents per pound in 1946.

Expenditure on Revenue Account amounted to Rs. 434,305, as against Rs. 397,882 in the previous year, the details being Research Revenue Expenditure Rs. 377,768, Interest on Government Loan Rs. 22,829 and Depreciation Rs. 33,708. The balance on Revenue Account, after allowing for depreciation, therefore amounted to Rs. 154,101 as against Rs. 67,358 in 1946.

Capital expenditure (nett) was incurred to the amount of Rs. 117,621, this comprising Rs. 65,846 on Assets and Rs. 51,775 in repayment of the Government Loan.

Nett liquid assets as at the 31st December, 1947, after allowing for liabilities under the Furlough and Passages Reserve and accrued interest on the Government Loan, amounted to Rs. 595,986. The liability of Rs. 631,422 under the Depreciation Reserve was, therefore, covered to the extent of 94 per cent. The outstanding balance of the Government Loan at the end of the year was Rs. 376,243.

St. Coombs Estate.—Fertilisers on the rationed scale were received regularly in the first half of the year but were later interrupted by the dislocation of transport brought about by the August floods. Blister Blight, though widespread, was frequently checked by periods of bright sunshine

in a light monsoon and loss was therefore less than might have been expected. The changes in the pruning programme designed as a measure against Blister Blight resulted in a larger acreage of tea remaining in plucking and this contributed with generally favourable growing weather to the production of a record crop 262,132 lbs. or 900 lbs. per acre — a figure 26,424 pounds in excess of the 1946 record of 235,706 pounds.

The crop was sold on the open market, and, as already mentioned realised a nett price of 170.86 cents per pound.

Cost of Production was 102.69 cents per pound, 3 cents lower than the previous year. This figure included 30.76 cents per pound due to Dearness Allowance for all estate staff.

The profit on the estate was therefore, Rs. 175,763 (Rs. 604 per acre) as against Rs. 46,795 in 1946.

The estate fortunately suffered little serious damage during the August floods.

PUBLICATIONS.

The *Tea Quarterly* was issued regularly and one Bulletin, the Annual Report for 1946, was also published.

ACKNOWLEDGMENTS.

The fullest co-operation was, as usual, received from the Ceylon Association in London, the Planters' Association of Ceylon and the Ceylon Estates Proprietary Association, the latter becoming the Agency Section of the Planters' Association during the year. The grateful thanks of the Board are due to these Associations for their help and encouragement.

Thanks are also due to the Ceylon Tea Propaganda Board, for the use of their Committee Room for some of the Board Meetings.

The Audited Statement of Accounts and the Balance Sheet for 1947 are attached, together with the report of the Visiting Agent and those of the Director, and Scientific Staff covering the technical activities of the Institute.

ROLAND V. NORRIS,

Secretary.

THE TEA RESEARCH INSTITUTE OF CEYLON

BALANCE SHEET AS AT 31st DECEMBER, 1947

LIABILITIES		ASSETS	
1946 Rs.	Rs. Cts.	1946 Rs.	Rs. Cts.
CREDITORS :—		DEBTORS :—	
5,885	5,173-34	Principal Collector of Customs	31,407-62
18,258	41,328-30	A. R. Westrop—1947 Sub. received in 1948	17-00
10,917	17,756-98	Due on 1947 Advertisements	1,477-00
85	45-00	Due from D. S. Pillai on tin foods supplied	16-60
		Kirkoswold Estate, Ltd. Expenses on	
		D. Nugawela	343-00
		J. M. Robertson & Co. Sayama Estate	
		Sub. for 1947	16-67
	15,403-40	Cheenthalaar Estate Sub. for 1947	29-44
	25,779-16	Fertiliser Control Bureau	1,789-81
	41,182-56	F. C. Daniel—due on 2 lb. B. M. Tea	-80
15,403	22,072-80	Sena Sugar Estate, Sub. for 1947	16-12
			35,114-06
Less : Payments in 1947		DEBTORS—RESEARCH :—	
		Ceylon Association in London £324-9-5	4,326-28
		Loans to Research Staff	3,501-29
		Deposits, etc.	177-18
		Accrued Interest on Fixed	
		Deposits & Investments	2,648-96
597,719	631,427-33	W. H. A. Robertson & Co.	
	5-32	£450-0-0	6,344-63
		Less : Charges on Contract £25	331-91
			16,666-43
			6,128-60
			22,795-03
DEPRECIATION PROVISION :—		ESTATE	
At 31st December, 1946	597,719-38		9,512
Added at 31st December, 1947	33,707-95	STOCKS-IN-HAND :—	
	631,427-33	Tea 40,934 lbs. at prices since realised	72,376-85
		Stocks on Estate	26,833-12
			99,209-97
		INVESTMENTS—(At Cost) :—	
		£2,300-0-0 3½% War Loan Bearer Bonds	32,434-76
		£2,063-18-1 4% Funding Loan 1960/90	29,928-06
		£6,750-0-0 2½% National War Bonds	
		1952/54	90,000-00
		Rs. 30,000/- Ceylon Govt. Loan 1957/62	29,512-50
		Rs. 15,000/- 3% Defence Bonds 1952	15,000-00
		Rs. 20,000/- 3% do 1949	20,000-00
			c/o 216,875-32
		Carried over	Rs. 157,119-06

c/o 648,267

Carried over Rs. 714,835-39

c/o 118,098

THE TEA RESEARCH INSTITUTE OF CEYLON

ESTATE WORKING ACCOUNT AS AT 31st DECEMBER, 1947

EXPENDITURE		INCOME	
1946	1946		
Rs.	Rs. Cts.	Rs.	Cts.
To ESTATE EXPENDITURE—REVENUE:—			
General Charges	68,300.35	By Tea Sales:—	
Upkeep	50,323.50	Colombo	449,918.07
Cultivation	19,719.66	Local	866.71
Harvesting	57,936.78	Broken Mixed	952.80
Manufacture	72,904.49	Bio. Dept.	628.14
			<u>260.565</u>
Brokerage and Handling Charges	269,184.78	Gratis	—
" Balance carried forward	7,176.69		1,567 "
	175,763.57		<u>452,365.72</u>
		Less: Paid to Tea Commissioner on local sales 1946	1,575.21
		" Motor Road Roller Account	<u>450,790.51</u>
			<u>1,334.53</u>
			<u>Rs. 452,125.04</u>

REVENUE ACCOUNT AS AT 31st DECEMBER, 1947

To ADMINISTRATION OF THE BOARD:—		By Balance from Estate Working Account	
1946	1946		
Rs.	Rs. Cts.	Rs.	Cts.
Planters' Association of Ceylon	240.00		
Travelling of the Board	3,120.80		
Clerical Staff	9,660.00		
Telephone Operators	1,022.62		
Office Peon	1,246.02		
Postages	738.93		
Stationery	2,016.11		
Advertising	367.10		
Telegrams, Trunk Calls,	457.71		
Printing	57.95		
Legal Expenses	52.83		
Auditors' Fees	1,301.58		
Contingencies	163.68		
Dearness Allowance	5,225.53		
			<u>10,231.75</u>
			<u>402,129.91</u>
			<u>Rs. 452,125.04</u>

Carried over Rs. 588,406.01

THE TEA RESEARCH INSTITUTE OF CEYLON

REVENUE ACCOUNT AS AT 31st DECEMBER, 1947—(contd.)					
Rs.	Rs. Cts.	Rs.	Rs. Cts.	Rs.	Rs. Cts.
1946 B/f 21,200		Brought forward	285,545-57	B/f 465,241	Brought forward 588,406-01
		To TRAVELLING OF STAFF :—			
2,729		Officers' Expenses	4,324-76		
188		Insurance of Car and License	173-56		
828		Driver's Wages	864-00		
268		Driver's Batta	389-55		
2,213		Running Expenses and Repairs	4,068-37		
601		Dearness Allowance	757-44		
		" MAINTENANCE OF BUILDINGS :—	10,577-68		
3,165		Laboratory	594-52		
3,519		Six Senior Staff Bungalows	3,724-82		
3,984		Junior Staff Bungalows	1,487-37		
340		Clerks' Bungalows	404-07		
873		Miscellaneous Lines and Buildings	2,575-43		
58		Guest House	15-32		
78		Passara Buildings	48-50		
1,176		Replacements and Renewals—Junior Staff and Clerical Staff Furniture	948-41		
—		Replacements, etc., Senior Staff Bungalows	241-90	10,040-34	
		" GENERAL SERVICES :—			
8,190		Electric Power	9,213-50		
920		Mechanic	980-00		
611		Telephones, Rent, etc.	728-25		
600		Roads	600-00		
1,179		Sanitation	1,026-35		
1,987		Water Supply	4,265-83		
264		Tappal, Lorry and Book Fees	413-50		
—		Nefikans and Drains	27-90		
1,156		Upkeep of Grounds	1,211-50		
705		Guest House	632-25		
3,683		Dearness Allowance	4,912-02	24,011-10	
		Carried over Rs. 330,174-69		c/o 465,241	Carried over Rs. 588,406-01

THE TEA RESEARCH INSTITUTE OF CEYLON

Dr.	REVENUE ACCOUNT AS AT 31st DECEMBER, 1947—(contd.)				Cr. Rs. Cts.
	Rs.	Rs. Cts.	1946 Rs.	Rs.	
B/f 290,945				330,174.69	Brought forward 588,406.01
To MISCELLANEOUS:—					
185	Incidentals		256.95		
10,720	Provident Fund—Senior Sc. Staff		10,627.68		
5,843	Do Junior Scientific Staff		5,629.21		
1,665	Do Sub-Staff		1,930.79		
15,000	Passages		15,000.00		
	Ceylon Nursing Association and				
240	Fraser Nursing Home		200.00		
542	Medical Fees, Sub-Staff		440.75		
1,188	Medical Scheme, Junior Staff		1,161.00		
4,096	Insurances		4,653.21		
942	Watchmen and Caretakers		1,556.23		
—	Conference Expenses		585.55		
240	Observatory Allowance		240.00		
904	Dearness Allowance		579.49		
—	Proportion of Superintendent's				
	Furlough and Passage		1,733.00	44,593.86	
14,214	RETIRING GRATUITY			3,000.00	
25,565	GOVERNMENT OF CEYLON LOAN				
	INTEREST ACCOUNT			22,828.98	
26,044	DEPRECIATION			33,707.95	
67,358	BALANCE			154,100.53	
Rs. 465,241				Rs. 465,241	
				Rs. 588,406.01	

(Sgd.) ROLAND V. NORRIS,
Director.

THE TEA RESEARCH INSTITUTE OF CEYLON

BULLETIN No. 29.

11

Dr.

CAPITAL ACCOUNT AS AT 31st DECEMBER, 1947

EXPENDITURE

To Additions
31-12-46 in 1947

Items
Scrapped
in 1947

Total

Rs. Cts. Rs. Cts. Rs. Cts.

TO LAND—INCLUDING
DEVELOPMENT

902,669.28 21,048.62 — 923,717.90

„ BUILDINGS & LINES

970,453.29 30,137.38 — 1,000,590.67

„ FURNITURE AND
EQUIPMENT

82,162.74 1,428.00 — 83,590.74

„ LABORATORY
EQUIPMENT

42,604.61 2,981.98 5.32 45,581.27

„ MACHINERY—
ESTATE

150,277.23 1,443.74 — 151,720.97

„ MOTOR ROAD
ROLLER

7,386.03 — — 7,386.03

„ MOTOR CAR

8,525.00 — — 8,525.00

„ MOTOR LORRY

— 7,860.00 — 7,860.00

„ EXPERIMENTAL
MACHINERY

29,705.38 951.81 — 30,657.19

Rs. 2,193,783.56 65,851.53 5.32 2,259,629.77

RECEIPTS

Rs. Cts.

By GOVERNMENT OF CEYLON:—

Loan on Mortgage @ 5½%
per annum

1,000,000.00

Less: Repayments to 1947

623,757.33

„ REVENUE APPLIED TO CAPITAL
PURPOSES TO 31-12-46

1,693,806.33

Add: SURPLUS

154,100.53

„ FUNDS OVERSPENT AS AT 31-12-46

71,959.79

Less: 1947 (Unexpended)

36,479.55

35,480.24

Rs. 2,259,629.77

(Sgd.) ROLAND V NORRIS,
Director.

REPORT

ON

ST. COOMBS ESTATE

FOR 1947

Superintendent.—Mr. F. C. Daniel since 1946.

Acreage.—The new plan of the Estate was received during the year and the revised acreages are given below :—

			A.	R.	P.
Tea in bearing	...	...	291	0	28
Land fit to open in tea	...	...	20	0	00
Buildings, Gardens	...	...	43	3	11
Waste Land, Ravines	...	...	32	0	24
Fuel Clearings	...	...	36	3	14
Total ...			423	3	37

Weather. —(Estate Gauge).		Rainfall	Wet Days
Registered in 1947	...	90.59 ins.	219
" " 1946	...	91.35 "	229

Crop :—		1947	1946
Estimate	...	250,000 lbs.	220,000 lbs.
Total Crop (including B.M.)	262,132	"	235,706 "
	900 lbs.		*810 lbs.

Yield per acre :—

This constituted a new record for the estate ; but it must be remembered that a larger acreage was in plucking owing to the postponement of pruning.

Prices and Total Crop Sold :—

Year	Total Crop Sold	Gross Price	Nett Price
1947	260,565 lbs.	173.61 cts.	170.86 cts.
1946	233,008 "	127.85 "	126.97 "

Cost of Production :—

		1947	1946
Estimate	...	107.06 cts.	94.35 cts.
Actual	...	102.69 "	105.67 "

Dearness Allowance included in above :—

		1947	1946
Senior and Subordinate Staff	3.58	cts.	2.63 cts.
Factory Staff	1.39	"	1.26 "
Factory Labour	2.24	"	2.34 "
Other Labour	23.55	"	23.00 "
Total	30.76	cts.	29.23 cts.

(* Recalculated to 291 acres.)

Profit on Estate Working :—

1947	...	Rs. 175,763
1946	...	„ 46,795

Capital Expenditure :—

1947	...	Rs. 41,949=16.00 cts. per pound
1946	...	„ 35,209=14.94 „ „ „

Manuring.—The policy remains to apply manure, as far as possible, at 6, 16, and 26 months after pruning. Assuming that the annual quota remains as at present, it will be possible to apply 35, 45, and 55 lbs. Nitrogen per acre at the first, second and third applications respectively. At this rate there would be a deficit of 448 lbs. Nitrogen at the end of 1953, but by that time it is hoped this could be made up.

Green Manure.—The only bush green manure used during the year was *Tephrosia vogelli*. Good crops were grown and forked in. Supplying of *Gliricidia sepium* is being continued. It was unfortunate that we were unable to intensify the supplying of *Grevilleas*, *Albizzia moluccana* and *Albizzia sumatrana* owing to various factors, during 1947, but a bigger effort will be made in 1948.

Pruning.—The programme was reviewed again owing to Blister Blight and pruning was postponed in some fields for pruning for dry weather recovery. One field however was taken as a demonstration example and a given number of rows pruned from July, 1947 to January, 1948. In part of this field the cut-across was used. Pruning has been generally lighter than normal, leaving all lateral branches and foliage below pruning level.

Weeding.—The whole estate remained on Estate Account, but family contracts are being given out now that the new plan has been received. *polygonum nepalense* was retained as a cover.

Pests and Diseases.—Blister Blight attacks were severe during the South-West Monsoon, in common with other estates in the district. Fields Nos. 5 and 8 suffered much damage and loss of crop. A few cases of root disease were observed, otherwise the estate remained free from other pests and diseases.

Labour—is sufficient and fairly satisfactory.

Lines.—Quarters for the baas, dhoby and k.p.'s were completed during the year and congestion in the lines relieved.

Factory and Machinery.—The factory is in the usual good order. The Sprinkler system has been completed. The Marshall Drier Direct-fire heater has not been satisfactory and has to be reconstructed.

General.—The estate is in good order and the crop harvested can be considered as very satisfactory even allowing for the fact that a larger acreage than normal was in plucking.

A. H. HALL
Visiting Agent.

REPORT

OF

THE DIRECTOR

TEA RESEARCH INSTITUTE OF CEYLON

FOR 1947

Finance.—While the receipts from the Research Cess in 1947 were Rs. 6,301 below the figure for 1946, the profit on St. Coombs Estate at Rs. 175,764, was higher by no less than Rs. 128,970. The total receipts for the year amounted to Rs. 588,406 an increase of Rs. 123,166 on the 1946 figure.

Expenditure on Revenue Account was Rs. 434,305, this being made up of Rs. 377,768 Research Revenue Expenditure, Rs. 22,829 Interest Charges on the Government Loan and Rs. 33,708 Depreciation. There was therefore a balance on Revenue Account of Rs. 154,101, the corresponding figure for 1946 being Rs. 67,358.

Capital Expenditure (Nett) including Rs. 68,846 spent on Assets and Rs. 51,775 in repayment of the Government Loan, amounted to Rs. 117,621. The surplus on total working was, therefore, Rs. 36,480. This figure, while satisfactory in itself, is, however, somewhat artificial in character. Due to the very high crop on St. Coombs Estate the profit on Estate Working Account, at Rs. 604 per acre, was abnormally high and it cannot be expected that this figure will be maintained. On the expenditure side again, the staff was below cadre and the expenditure under this head therefore below normal. Everything indicates that with a full staff and the enlarged programme of work demanded, the cess will have to be increased in the near future. An allowance of 0.14 cents per pound of made tea cannot be considered adequate provision for research under the conditions now prevailing.

Full details of receipts and expenditure will be found in the accounts published earlier in this report.

St. Coombs Estate.—Climatic conditions generally were favourable to crop. In spite, therefore, of late deliveries of fertilisers in the latter part of the year due to the August floods, and Blister Blight attack, a record crop of 262,132 pounds, or 900 lbs. per acre, was harvested for which a nett price of 170.86 cents was obtained. Some part of this enhanced crop was no doubt due to the change in the pruning programme necessitated by the incidence of Blister Blight, in consequence of which a larger area than usual was in plucking for the first nine months of the year.

Blister Blight attacks, though wide spread during the S. W. monsoon, were much lighter in intensity than had been expected, due to the frequent breaks in the monsoon and resulting sunny periods, the latter being the most potent factor in checking attacks.

Further data concerning the estate will be found in the report of the Visiting Agent.

Publications.—The Tea Quarterly was issued regularly and one Bulletin, the Annual Report for 1946 was published.

Staff.—The Director was on leave until June, Dr. Gadd acting for him until May when he also went on furlough and Dr. Eden assumed charge. It was again found impossible to fill the two existing vacancies in the Senior staff, Mycologist and Agricultural Officer. After Dr. Gadd's departure Dr. Tubbs was placed in charge of the Mycological Division in addition to his own duties.

The Assistant Scientific staff was also under strength. Here again great difficulty has been experienced in recruiting suitable men owing to the great scarcity of men with any knowledge or experience of research methods.

In consequence, these members of the staff who were at St. Coombs had an extremely difficult and arduous year. The incidence of Blister Blight and a renewed interest in tea manufacture naturally resulted in a very large increase indeed in the advisory work of the Institute. Addresses to District Planters' Associations and visits to estates were greatly in demand and occupied much of the time of the staff.

Fertiliser Rationing.—Dr. Norris continued as Organiser, Fertiliser Rationing, Dr. Eden acting for him during his absence on leave. Fertilisers were again in very short supply as regards nitrogen and Ceylon's allocation was very much smaller than had been hoped for. With somewhat irregular shipments, the position became somewhat difficult in the latter part of the year. This was intensified, so far as up-country estates were concerned, by the breaching of the main line of the railway as the result of the August floods, in consequence of which deliveries were held up for a considerable time. The railway authorities, however, made every effort to provide alternative transport over the flood gaps and, together with the admirable emergency lorry service organised up-country, largely due to the energy of Mr. Leaning, the lag in fertiliser deliveries was made good by the end of January, 1948.

The position in regard to tea, however, remains one of anxiety. In spite of an increase in the nitrogen quota to tea estates in 1946, this quota is still well below what tea estates could usefully employ, being probably only about two-thirds of what would be normally applied. In recent times an increasing number of reports is being received, particularly from up-country districts of "weak" areas carrying much less foliage than normal. The effect of the reduction in nitrogenous manure since the outbreak of the war is in fact now becoming more prominent. It is true that this effect has been masked by climatic conditions favourable to crop and, probably, by much harder plucking. Yields, therefore, have been maintained at a much higher level than might have been expected but, taking the long view, not without detriment to the conditions of the over considerable areas. It must be expected that these effects will be intensified in the near future, particularly if unfavourable climatic conditions are experienced and, even when fertiliser supplies become more freely available, an appreciable time lag must be expected before the position is restored.

These facts, and the urgent need for a larger quota of nitrogen for Ceylon, have been continuously stressed in the representations which have been made to the International Committee responsible for fertiliser allocation. These representations have been strongly supported by the Ceylon Government Officials concerned but there is, unfortunately, little likelihood of any material improvement in the position in the immediate future.

TECHNICAL.

In this part of the report attention will be focussed chiefly on Blister Blight and tea manufacture, readers being referred to the reports of the technical officers concerned for details of other aspects of the Institute's work.

It would be true to say that the Industry looked forward to 1947 with considerable apprehension and uncertainty. Reports of the heavy damage caused by Blister Blight in South India naturally led to anticipations of similar disasters in Ceylon. Fortunately, owing to the fact that the disease only appeared in Ceylon in October 1946, there was a relatively short time left in which the disease could flourish before it was checked by the ensuing dry weather. This gave time for protective measures to be devised and made known. The most urgent of these problems was of course the question of pruning. The fact that the disease only attacks young leaves or shoots naturally suggested that a radical alteration in the times of pruning would be required, so that the recovery period should occur during climatic conditions unfavourable to the disease in order that the new shoots should have the maximum chance of survival and an adequate leaf canopy be established as rapidly as possible. This principle was immediately stressed by the Institute and estates advised to arrange pruning programmes accordingly. This advice was accepted by a very large proportion of estates, though naturally in the short time available it was impracticable to cover all areas on these lines. It may at once be said that the procedure suggested has proved sound in every way. Fields pruned into the dry weather in general came back from pruning well and without serious damage. Others where pruning had to be delayed so that recovery occurred in weather favourable to Blister Blight suffered severely. In addition to alterations in the time of pruning, a lighter type of pruning was also advocated in order that at least some leaf, should be available to assist in maintaining the bush should the new growth become badly attacked by the disease.

The next cause for speculation was as to the damage and loss of crop which might occur under conditions favourable to the disease, i.e., during the South West monsoon in the wet zones and in the North East monsoon in Uva and the dry zones. Here circumstances proved favourable. The South West monsoon was light in character and interrupted by frequent short spells of bright sunny weather. Though frequent sharp attacks of Blister Blight were experienced, quite sufficient to indicate what the disease could do if given a free run, such attacks were checked by the bright intervals and, generally speaking, the intensity of attacks and consequent loss of crop were very much less than had been anticipated. So much was this the case that for a time an atmosphere of complacency tended to replace the universal alarm which had hitherto prevailed. It may be said at once that there is no justification for such complacency though it is equally true to say that the disease is unlikely to become a menace threatening the existence of the tea industry,

Two further measures were suggested to minimise attacks and reduce loss of crop. It will be appreciated that exposure to sunshine is the main check in infection and for these reasons the recommendation was made that in areas of heavy shade such shade should be thinned and controlled. Misunderstanding undoubtedly arose concerning this point and it is unfortunate that in some cases shade was almost entirely removed — a quite unnecessary step. Shade is of importance not so much under monsoon conditions as in the intermediate periods, and particularly in misty areas where the exposure of the tea to a few hours of sunshine may make all the difference between a new attack and an escape from infection. The question of reducing shade must, therefore, be considered in the light of local climatic conditions. As a means of conserving crop it was also suggested that closer plucking, i.e., plucking at shorter intervals, should be adopted for short periods during times when the young flush would almost certainly become infected. There is a period of some three weeks between infection and the development of the white blister. Clearly nothing is to be gained by leaving the flush to become unfit for manufacture, at which time it will also be of little use to the bush, and loss can be avoided therefore by shorter rounds. It is to be feared that this advice was also misinterpreted in some quarters with the result that bushes were unmercifully stripped during bad Blister Blight periods — a feature which can only have disastrous consequences.

A word must be said about spraying against Blister Blight. Experience has shown that the spores are rapidly destroyed by sprays of the cuprous-oxide type. Spraying under normal circumstances is not, however, a practical proposition with tea in plucking. The frequency with which the operation would have to be carried out, the difficulties of penetration, and the risk of taints all combine to render this practice uneconomic. Spraying has, however, a useful purpose to serve with young plants in nurseries and, in certain circumstances, e.g. in regions subject to mist for long periods, in areas recovering from pruning when conditions are favourable to infection.

One other factor, likely to be of major importance taking the long view, must be referred to. It was at an early date noticed in areas badly affected with Blister Blight that certain bushes could be found which showed little or no signs of infection even under the most unfavourable conditions. In other words it appeared that such bushes were highly resistant to the disease. This early observation has been confirmed by later experience and it cannot be doubted that a careful search would reveal a considerable number of such resistant bushes. It is too early to speak yet of "immune" bushes but the existence of more resistant types is a factor of the highest importance. The vegetative propagation of tea has now been shewn to be a practical proposition and the progeny of such types produced by vegetative propagation will provide in due time a large amount of planting material having the same resistant qualities and, therefore, invaluable as a long term protective measure against Blister Blight.

As has already been reported on previous occasions, the Institute has for a considerable term of years been engaged on selection work in tea and a considerable number of clones of material possessing high yielding and good manufacturing quality has been under test. These clones were selected before Blister Blight invaded Ceylon and their usefulness has naturally now to be reassessed in relation to their resistance to the disease. As was to be expected many of these early selections shew no special resist-

ance to Blister Blight. It is satisfactory, however, to record that resistant varieties do occur amongst the Institute's selections and these clones are naturally now receiving further examination from this point of view.

In the meantime every effort is being made to discover further resistant bushes. It is to be hoped that all estates subject to Blister Blight will engage actively in this search.

Before leaving the subject of Blister Blight it is satisfactory to note that further experience supports the view expressed that the disease is likely to be of little importance at elevations below about two thousand feet. At such elevations the temperature is probably the controlling factor.

Tea Manufacture.—The work on tea selection and vegetative propagation was, as has already been mentioned, originally designed to provide planting material of much higher yielding capacity and of proved manufacturing quality. In regard to tea production generally, the view may be expressed that there is no necessity to increase the overall output of Ceylon tea. Accepting this view, the fact remains that better planting material would enable the same crop to be produced on a considerably smaller acreage and thus lead to a substantial saving in the cost of production, a factor which now demands the closest consideration.

It is this consideration which underlies much of the Institute's experimental work on tea manufacture. Can methods be devised which will reduce the cost of manufacture? There is considerable evidence that the answer is in the affirmative. In all such research certain limiting factors have, however, to be considered. The consumer and the tea industry generally are highly conservative in outlook, and, in particular, changes in the traditional appearance of the manufactured leaf are strongly disliked, quite apart from the character and quality of the liquors in question. Some may hold that this insistence on "appearance" is overdone but one must naturally assume that the buyer is in the best position to know what his public demands and as the customer is always right his demands have to be met. In trying to evolve new and cheaper methods of tea manufacture this consideration has, therefore, continually to be borne in mind and it considerably increases the complexity of the problem.

The prosperous days during which the whole of the Ceylon tea crop was sold on contract at a fixed price naturally reduced enquiries about manufacture to a minimum. This had at least one fortunate result in that more time was available to the staff of the Biochemical Division to undertake fundamental work. Investigation into the chemistry of tea fermentation in consequence made good progress and has linked up well with fundamental work on the chemistry of tea carried out in London under a scheme financed jointly by Ceylon, India and the Netherlands. This is of too technical a nature to detail here but has an obvious practical application.

Advantage was, however, taken of the temporary easing off in pressure to try out certain radical alterations in manufacturing methods. Before the war successful results were obtained by the use of the Clivemeare roller to replace most of the normal rolling procedure and the teas produced were well received. Certain alterations in grading, however, resulted and with tea selling under the contracts to standard gradings, work on these lines ceased temporarily to be of immediate practical importance. An obvious development of the use of high pressures such as occur in the Clivemeare roller was to investigate the practicability of such methods using unwithered leaf. The savings in cost, if the necessity for withering leaf could be avoided, are obvious. A certain amount of success

was obtained in these preliminary experiments, the time of manufacture being reduced to a very few hours from field to bin, and strong coloury liquors and brilliant infusions being obtained. Certain tasters, however, were of opinion that these liquors had a different character from normally made Ceylon teas. Subsequent work suggested that this difficulty could probably be overcome. The real difficulty was, however, that of appearance, the teas produced from unwithered leaf being markedly different in this respect, to the traditional forms. Investigation of this problem has not been abandoned, but for further experimental work on these lines additional small scale plant is required which it has not yet been possible to obtain.

Work in the main has, therefore, had to be restricted to experiments using withered leaf. This has led to the development of epicyclic rolling, the general principles of which have been explained in previous publications. This work aroused considerable interest and it is unfortunate that in some cases the method has been prejudiced by the premature introduction of epicyclic devices without proper technical advice and without regard to certain precautions stressed by the Institute. That this method has a part to play in the future as one means of reducing the cost of manufacture, there is little doubt. Here again the controlling factors referred to earlier come into play. Very satisfactory liquors, normal in type, are readily produced, the difficulty again is in regard to appearance. With good quality leaf this difficulty is of little importance, but with coarse, stalky leaf or with damaged leaf — both of which are much more in evidence than formerly — epicyclic rolling seems to show up these defects more than the conventional methods.

Epicyclic rolling methods can readily be adjusted to meet different requirements in regard to grading and, provided the difficulty in regard to the quality of the fresh leaf can be corrected, the method should have a wide application. Work on this method of rolling is, therefore, being actively pursued.

Advisory Work to Small-holders.—Work has continued in the Gampola, Baddegama and Morawaka areas. During the war and immediately afterwards, such work was considerably handicapped by the pre-occupation of the small-holders on food production and difficulties in regard to labour. Conditions in this respect have improved and more interest is being taken in the holdings. Better prices for tea have resulted in better prices being paid for small-holder's leaf. Such improved prices carry with them, however, the temptation to pluck anything possible from the bush and the quality of the leaf produced, therefore, leaves much to be desired. Competitions in these areas are being resumed and this will it is hoped help to encourage more reasonable methods.

General.—The number of enquiries for advice received by the Institute provides a very good barometer of the general condition of the Industry. In times of prosperity enquiries fall off; a set back in any branch of production leads to an immediate increase. The Blister Blight threat has naturally, therefore, led to an immense increase in advisory work including addresses to District Planters' Associations, visits to Estates, and visits to the Institute by planters. A steady increase in the number of enquiries in regard to manufacture suggests that a revival of interest in the factory is taking place, and the long continued rationing of fertilisers and anxiety in regard to the poor appearance of the tea in certain areas

is similarly producing calls for assistance in this direction. The nett result is that a very heavy burden indeed has fallen on a reduced staff which is likely to be even more onerous in the coming year. I cannot too deeply express my indebtedness to all members of my staff, of every grade, for the manner in which they have met this situation.

In conclusion, it is a pleasure to acknowledge the confidence which has been shewn in the Institute in the past difficult year and the support which has been forthcoming from all the Associations concerned with the Industry.

We have again to express our great indebtedness to Mr. R. H. Horne and the other Tea Tasters in Colombo who have most generously placed their experience at our disposal by reporting on our experimental teas.

Our grateful thanks are also extended to those Agencies and Superintendents who have afforded facilities for experimental work on their estates and to the planting community in general for the hospitality extended to members of the staff on their visits to estates.

The reports of the Scientific Staff are appended.

ROLAND V. NORRIS,
Director.

REPORT

OF

THE PATHOLOGIST

FOR 1947

Organisation.—The Board of the Tea Research has approved the fusion of the Mycology and Entomology Divisions to form a Pathology Division on the return of Dr. Gadd from leave. In view of the concentration of the two divisions on blister blight investigations during 1947 the reorganisation is anticipated in this report.

Staff.—The Plant Physiologist was in charge of the Mycology Division throughout the year, and of the Entomology Division after the 8th May, in addition to his own duties.

Publications.—The following papers were accepted for publication:—

Gadd, C. H. and Loos, C. A.—The Basidiospores of *Exobasidium vexans*.—Trans. Brit. Myc. Soc. (Awaiting publication).

Loos, C. A.—Notes on Free-living and plant-parasitic nematodes of Ceylon. 4.—*Spolia Zeylanica*. (Awaiting publication).

MYCOLOGY SECTION.

Advisory.—The year under review was noteworthy for the heavy burden of Advisory work resulting from blister blight. 1,260 letters were received and 1,249 despatched, compared with 535 and 531, respectively in 1946, 345 consignments of diseased material were dealt with. No disease other than blister blight was abnormally prevalent.

Lectures were given to Planters' Associations on eighteen occasions and sixty-nine visits to estates were made.

Root Diseases.—*Poria*.—In 1937 the Mycologist described methods for the field treatment of *Poria* that led him to conclude "*Poria* as a root disease can be completely eradicated from our ten fields" (*Tea Quarterly*, X, page 35, 1937). Ten years later it is not out of place to draw renewed attention to that conclusion and to discuss it in the light of subsequent experience. The accurate records of root disease areas kept at St. Coombs during this period show conclusively that removal of dead and dying bushes only is entirely ineffective in limiting the disease and that the refinement of removing in addition those neighbouring bushes on the roots of which *Poria* can be detected is not, in practice, an adequate solution to the problem. Only the removal of every bush on which any trace of the disease can be detected *together with a complete ring around them of apparently healthy bushes* is in practice sufficiently effective to justify the large amount of labour involved. In those disease

areas thoroughly treated on these lines no further trouble has been experienced. Wherever less thorough methods have been used, the disease has caused continued loss, and heavy and unnecessary additional expense in treating areas again.

It has been objected that post-war labour conditions are such that thorough treatment on the lines discussed is prohibitively expensive. This contention cannot be maintained if it be admitted that one very adequate reason for eliminating disease in existing areas is to prevent wholesale dissemination throughout the estate. The war years have left a considerable heritage of preventive work to be undertaken and greater attention to the subject is overdue in many districts.

Blister Blight—continued, though fortunately relatively light, attacks of blister blight in all districts above 1,500 feet during the year demanded a large amount of advisory work to be undertaken in addition to maintaining the progress of investigations upon the disease itself. As knowledge concerning the disease increased, information was published without delay in the *Tea Quarterly*. No useful purpose would be served by recapitulation here, and it is sufficient to draw attention to the following :—

- (1) Interim Index of subjects discussed in relation to Blister Blight (Circulated with Parts III and IV of the *Tea Quarterly*, Vol. XIX, 1947).
- (2) Proceedings of the Conference held in 1947.
- (3) The collection of blistered leaves (Dr. C. H. Gadd—*ibid.* p. 17).
- (4) The Control of Blister Blight of tea (*ibid.* p. 34).
- (5) An Interim Report on Blister Blight (*ibid.* p. 41).
- (6) Notes on Blister Blight (*ibid.* p. 50).
 - (i) Red blisters.
 - (ii) Attacks in old tea fields.
 - (iii) Resistance of individual bushes and clones.
 - (iv) Felling shade trees.
 - (v) Cutting-across.
 - (vi) The low cut-across.
 - (vii) Alternative hosts.
 - (viii) The influence of manuring on the incidence of Blister Blight.
 - (ix) Time of pruning in districts receiving both monsoons.
 - (x) Resistant bushes.
- (Attention is drawn to the correction slip issued in connection with pages 54-5).
- (7) Spraying and dusting in the control of Blister Blight of tea (*ibid.* p. 78).
- (8) Report on a visit to South India (*ibid.* p. 109).

These publications referred in the main to the occurrence of the disease and its control under field conditions. Throughout the year laboratory investigations upon the germination of, and infection by, the fungus were carried on by Mr. C. A. Loos and Mr. S. N. Vander Wal. The characteristics of the fungus render such investigations peculiarly difficult, and it is not, therefore, proposed to report the work in detail until it has

progressed to a more final stage. Such "backroom" work is not always productive of immediate or spectacular results but is nevertheless essential to future refinement of methods of control originally based upon field observation.

It is appropriate to record here the writer's appreciation of the assistance received from all members of the Institute during the year and especially those members of the assistant staff who, in the laboratory or field, carried out the laborious and detailed work necessary to ensure that advice given to the Industry was based on sound and adequate foundations.

ENTOMOLOGY SECTION.

Advisory.—477 letters were received and 559 despatched, an increase on the previous year. 137 consignments of insects were received for examination. No insect pest was unduly prominent during the year, though small outbreaks of Nettle grub in Uva were locally more severe than normal.

Blister Blight.—The Institute's pre-occupation with this disease led to inevitable diversion of effort from other investigations. At Passara, the Entomological Staff collected data on the relation of manuring to the degree of infestation throughout the year, while at St. Coombs they were utilised for the greater part of the year on the whole-time collection of blister blight data from field experiments. The results are summarised elsewhere, but the prolonged and detailed work involving the examination of the effects of various treatments upon the distribution of a total of several million blisters has made a substantial contribution towards the present knowledge of the disease and one which has justified the necessary diversion of effort from strictly entomological problems.

Shot-hole Borer.—Field observations upon shot-hole borer continued throughout the year. In addition to the continuance of the records of branch breakage due to the presence of galleries in the stem reported in the last Annual Report, an additional series of records of breakages occurring during blister blight collection was maintained. It was found however that the extra breakages resulting from the passage of additional labour through the plots was causing so marked an increase in total breakages that further recording of blister blight frequency was abandoned. The data will be dealt with by the Entomologist on his return.

Nettle Grub.—A number of minor outbreaks occurred during the year in Uva, but natural agencies (parasites, birds, and 'wilt') were again efficient in preventing serious trouble. Observations upon naturally occurring parasites were continued. The Nettle grub *Thosea cervina* was on several occasions found to be very heavily parasitised by an *Apanteles* species. Euplectrinids and Braconida were again frequently found on *Thosea* and *Natada* spp., while a Tachinid new to Ceylon, *Spoggosia grandis* Macq. was found parasitising *Thosea cervina*.

Tortrix.—The control of Tortrix (*Homonae coffearia*) by *Macrocentrus homonae* maintained its efficiency. Collections of Tortrix caterpillars from Dimbula and Uva were heavily parasitised.

F. R. TUBBS,
Plant Physiologist.

REPORT

OF

THE AGRICULTURAL CHEMIST

FOR 1947

Staff.—The Agricultural Chemist relinquished the Organizership of Fertiliser Rationing on the return of the Director. He acted as Director for two short periods covering part of the Director's furlough and his visits to S. India from May 1st to June 10th and August 5th to 27th. respectively.

There have been no changes in staff during the year. The department is in need of graduate assistance on the soil side in the form of either a senior assistant or a research assistant. At present the chances of recruiting any one, with adequate background or training, are negligible.

The problem cannot be satisfactorily solved by training here. To function really adequately, a department needs the combination of recent technical training of the highest order and of mature experience, and this can only be obtained by periodical recruitment from large and authoritative centres of research and by study leave.

Advisory.—Letters received 303; letters despatched 177.

The main topic in advisory correspondence is the best use to be made of rationed supplies of fertilisers. With the advent of Blister Blight, and the alteration of pruning periods and with the altered distribution of crop, advice is being sought regarding times of manuring. This is not a matter which can be summarized as a generalization.

Soil Phosphates.—Knowledge about soil phosphates is still lamentably scanty despite persistent attempts to clarify the subject. Some progress has been made in defining the forms in which phosphate is held in the soil, but there is still much to be learned about the mobility and availability of phosphorus compounds in agricultural soil. The almost general consensus of opinion as reflected in text books is that soluble forms of phosphate tend to become changed into sparingly soluble forms and that, in particular, the phosphates of iron and aluminium are of little use to the plant as sources of nutrient. One of the arguments used to explain the success of certain experiments on 'fertilizer placement,' in which fertilizers are sown in concentrated bands instead of being broadcast, is that by this technique the reversion to insoluble forms is delayed and the plant has a better chance to use the available phosphate.

As regards tropical soils the position is particularly confused. Iron and aluminium are highly concentrated in these soils so that reversion may be the more easily brought about. On the other hand many of them

being acid may give more satisfactory results with insoluble phosphates than are experienced on temperate soils. If these views are correct, then it may be more profitable to use mineral phosphates more freely than superphosphate on our soils. Since rationing of fertilizers started all the phosphate used has been mineral phosphate. Recently published work from Malaya gives no indication that rock phosphates are inferior to superphosphate.

There is no adequate method for measuring chemically the 'availability' of soil phosphates. Consequently when it is said that in tropical soils the availability may suffer in comparison with temperate soils, there is no yardstick wherewith to give precision to such a statement. There are however one or two observations gained from our experimental work which suggest that the fixation of phosphates with its assumed corollary of immobility and unavailability is a characteristic that needs more scrutiny than it has had in the past.

There is evidence that soils regularly manured with superphosphate over a period of years retain a reserve of available phosphate that is quickly mobilized by the vegetation growing on these soils. The Annual Reports for 1943 and 1944 reported the phenomenal growth of weeds on phosphatic plots when weeding was stopped for 3½ months, a response which in terms of dry matter was 250 per cent above the no-phosphate plots. It is an important point to bear in mind that there had been no application of phosphate to these plots for twelve months previous to the weed trial. The phosphatic response was also reflected in the composition of the tissues of the weeds as shown in the analytical details given in Table I.

TABLE I
Produce from Phosphatic Plots
Percent Phosphoric Acid in Dry Matter

Receiving	Weeds	Tea Foliage
P _o	0.351	0.788
P _{so}	0.627	0.971
P _{so}	0.853	1.073

A similar picture of phosphate absorption is given by the figures for tea foliage-leaf pruned at the end of the pruning cycle. The effect of the increments is not so marked as in the weed data and the period of growth is very much longer.

As to the mobility of phosphate in this soil, a typical high elevation tropical red loam, there is direct evidence in the soil-phosphate figures. A period of eight years manuring has made its effect felt on both the top soil (0 in.-12 in.) and the subsoil (12 in.-24 in.) The interesting feature of the data is that the effect of the manuring is as plainly detected in the subsoil as in the top soil. (Figure I). Since cultivation operations do not disturb the subsoil and 70 per cent of the easily decomposable feeding roots are found in the first 12 inches, the accumulation of phosphate in the lower levels must be ascribed to natural mobility over considerable periods of time. In considering problems of this kind account must be taken of the fact that chemical changes take place at least twice as rapidly at prevailing temperatures as in temperate latitudes.

It is proposed to follow up these indications both by field and laboratory work. The field work will include a comparative study of response of both tea and weeds to superphosphate and mineral phosphate. The appropriate experiments for this have already been laid out. The laboratory

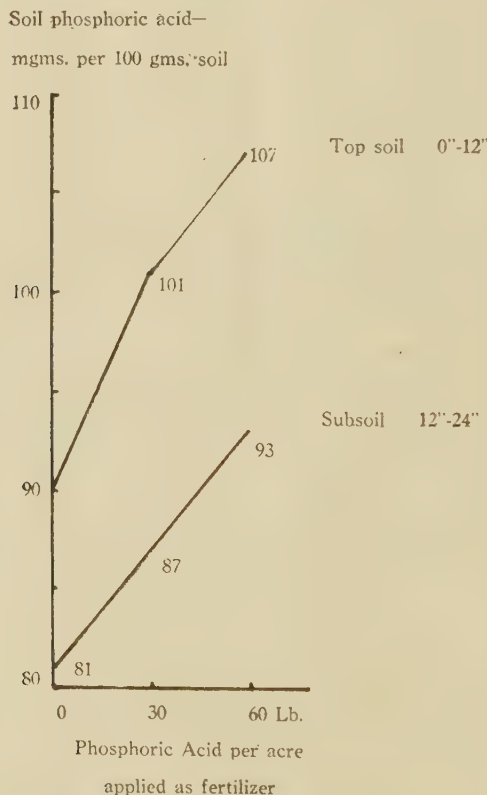


Figure I.—Penetration of Superphosphate in a Tropical red earth.

work will investigate soil changes and phosphatic uptake in the vegetation, and will also attempt the fractionation of the various types of phosphate. At the moment this latter aspect of the work is at a complete standstill because it is still impossible to procure supplies of anything except the most commonly used routine chemical reagents, and even for some of these, export licences have been refused by the Board of Trade.

In conjunction with this work, it is proposed to start trials of fertilizer placement. For tea the most convenient method of achieving the concentration needed would be by the use of tablets instead of granules or fine crystals. So far it has not been possible to locate in Ceylon any apparatus for the production of tablets in sufficient quantity and of suitable size. The machine used experimentally for tea is too slow and produces tablets of too large a size.

Cultivation and Weeds.—Since the Board gave instructions that weed studies should form a major line of research in the Institute's experimental

programme, the existing trials have been further extended. So far two weed experiments have been carried out and reported on:—

(1) The clean-weeded and selectively weeded trial that is part of the cultivation trial.

(2) The short term weed investigation on the factorial manurial trial.

To these has been added (3) a weed ecology trial. The first of these experiments regards weeds as an entity and makes no attempt to distinguish between the various classes or species, except that grasses are eliminated from the selectively weeded plots. Attention has been concentrated on the effect on tea of weeds which are regarded as a factor in the growth of the crop and are not themselves an object of study.

The results so far obtained show consistently that weeds depress the yield of tea though not so severely as is commonly supposed. The average effect in the first cycle of three years was 8.6 per cent; in the second of four years 1.5 per cent and in the third (four-year) cycle 8.6. Variation in climatic conditions plays a large part in determining the size of the loss but there is a further factor. Table II shows the crop losses for the two comparable four-year cycles.

TABLE II
Gain or Loss of Crop due to Weeds

	1st year	2nd year	3rd year	4th year	Cycle
Second cycle ...	- 7.4	- 7.0	- 1.4	+4.3	- 1.5
Third cycle ...	-16.5	-14.8	- 9.5	- 1.2	- 8.6

The figures in heavy type are significant losses in the sense that a loss as great as this, unconnected with the presence of weeds, could not occur more frequently than once in a thousand times. It is safe therefore to assume that these losses are genuinely ascribable to weed competition.

The remarkable feature of these results is the manner in which the losses decrease as the pruning cycle advances. In the second cycle the fourth year shows a gain, but the gain falls short of what can be reliably ascribed to the effect of weeds. At any rate in both cycles the deleterious effect of weeds virtually ceases in the last year and in one of them it had done so at the end of the second. The plain interpretation of these results is that the best method of controlling weeds is to grow good healthy tea which will compete for light, moisture and nutrients with weeds and hold them in check.

There has been much discussion of why during recent years weeds have proved so troublesome. Doubtless weather conditions and labour shortage have been very important factors, but there is another possibility. It cannot be gainsaid that for a decade the tendency in pruning has been toward harder styles, leaving a less spreading frame and entailing longer periods of recovery. This procedure gives weeds their best chance to germinate and establish themselves. It will be of interest to see how the lighter pruning recommended as a protection against blister blight will react on the weed problem.

One of the questions raised by selective weeding is whether or not the weeds interfere with the response of the tea to manuring: whether in fact they 'steal the manure.' This experiment has throughout given a clear-cut answer to that question. They do not, under our conditions. There is a good nitrogen response on this experiment as can be seen by referring to last year's report (p. 37). The weeds it must be remembered are not removed from the selectively weeded plots (with the exception of grass). When weeds are removed it is known that substantial losses of nutrient do occur (Report for 1944, p. 41). If the response to manure is examined on the clean weeded and on the selective plots, it will be found that in the four years of the cycle the response was not consistently greater on the one particular set and in every instance the difference was small. In the first and third year the clean weeded plots were superior in response by less than one and a half per cent. In the second and fourth years they were inferior by less than one per cent. Such small differences are of no importance. Expressed in terms of percentage of the mean yield the results are given in Table III.

TABLE III

Gain or Loss in response to Fertilizer of the Clean weeded plots compared with Selectively weeded
(Percent of the mean yield)

1st year	2nd year	3rd year	4th year
+ 0.84	- 0.68	+ 1.44	- 0.54

The effect of excessive cultivation continues to be in the direction of decreasing yield. The results for the third cycle are given in Table IV. The effects of intensive cultivation are only shown with certainty in the second and third year. When the results are analysed in greater detail, it becomes evident that the extra cultivation depresses yield less on the selective plots than on the clean weeded ones. This is because there are two opposing factors at work. Intensive cultivation considered as an

TABLE IV

Normal (once yearly) versus Intensive (thrice yearly) cultivation
Yield lb. per acre

	1st year	2nd year	3rd year	4th year	Cycle
(a) Normal ...	251	925	1167	1188	3531
(b) Intensive ...	245	887	1113	1160	3405
Diff. (a-b)	6	38	54	28	28
Percentage of mean yield ...	2.4	4.2	4.7	2.4	2.4

isolated factor does harm but intensive cultivation destroys weeds which themselves do harm. The manner in which the two factors weeds and cultivation interact, can be seen from Table V, where as an example the data for the second year are set out.

TABLE V

Effective of Intensive Cultivation on the Comparison between
Clean and Selectively weeded areas

Lb. per acre yield

Cultivation ...	WEEDING	
	Clean	Selective
Normal ...	505	420
Intensive ...	468	419
Difference ...	37	1

Intensive cultivation depresses yield by 37 lb. per acre on the clean areas where it has no positive contribution to make. On the selective plots, the yields are altogether lower, but the difference due to type of cultivation is negligible.

There is nothing further to report on the response of weeds to manures, but the new experiment mentioned earlier in this report, and in the report for 1944 (p. 42) will give additional information. When this experiment was designed it was expected that, as in that on manurial response of weeds, the work would be carried out in collaboration with Dr. T. E. T. Bond. Dr. Bond's departure from the Institute has narrowed the scope of this trial very considerably, for the plan was to follow the succession of weeds on the area over a considerable period and this needs the constant attention of a botanist with a leaning towards systematic botany and ecology. The work is however being continued on the lines which Dr. Bond and I discussed together.

There is a further threat to this experiment, hinted at previously, which is that the cut-across pruning will blur the distinction in weed growth between the early part of the cycle and the later. The weed and the manurial treatments have been in operation on this trial since 1944. It is due to be brought into bearing in 1948. This is a long range investigation and ten years would not be too long to wait for a detailed exposition of the results. Certain general features have been noted in the last 3-4 years and these are reported.

The treatments given in the experiment are as follows:—

Weed treatments:—W1.—Weeds allowed to grow unchecked for several months and then removed and buried in pits *in situ*.

W2.—1st half of cycle clean weeded monthly.

2nd half of cycle as W1.

W3.—1st half of cycle as W1.

2nd half of cycle clean weeded monthly.

W4.—Clean weeded continuously.

In addition there are manurial treatments, viz: K_0 versus K_{80} ; and P_{15} versus P_{30} . The first noticeable feature is that in the absence of the customary monthly scraping weeds do not grow with alarming rapidity. The continual scraping provides a perfect seed-bed for the millions of

seeds normally found in the top soil (Report for 1944, p. 50). In the absence of this at no time was weed growth on plots W1, 2 or 3 so prolific that a skewer dropped at random touched a weed on more than 83 per cent of occasions. The length of time during which weeds were left undisturbed varied between five and 14 months. In dry weather many of the annual type of weeds die off after producing seed, but this seed does not in these circumstances find a receptive seed bed awaiting it.

Continual scraping often leads, as common observation shows, to the predominance of one species (*e.g.*, *Drymaria cordata*) if the species in question has a short period of growth between seedling and mature conditions. The continual removal of other species which would otherwise compete, favours the dominance of one or two weeds. Where the weeds are left and only removed infrequently no such domination occurs. After four years the average number of species recorded is 5.7 for plot W1, and 5.9 for the plots W2 and W3 which have a period of clean weeding.

There is some fluctuation in the frequency of individual species. The grass *Digitaria longiflora* (Usi-pillu T.) shows signs of increasing whilst *Stenophyllus capillaris*, (a tufted sedge, usually mistaken for a grass) is decreasing in almost identical proportion. Manuring shows no signs of increasing or decreasing the variety of the herbage. Over the four-year period the data for average number of species found are:—

K ₀	5.5	P ₁₅	5.8
K ₆₀	5.8	P ₃₀	5.4

Besides having a fundamental aspect bearing on weed succession, this experiment should give concrete practical guidance on whether less frequent weeding with burial in pits will conserve fertility better than the traditional method.

T. EDEN,
Agricultural Chemist.

REPORT

OF

THE PLANT PHYSIOLOGIST

FOR 1947

Staff.—Charge of the Mycology Division was continued throughout the year. In addition, charge of the Entomology Division was assumed from 8th May on the departure of Dr. Gadd on leave. The diversion of staff from the Plant Physiology Department to assist in the field study of blister blight referred to in the last Annual Report was continued and extended to include the staff of the Entomology Department from May onwards. The following report, as in the case of the Entomology Department, therefore, summarizes the results of efforts to maintain the existing lines of work rather than the extensions it had been hoped to make during the year.

In August a short tour of the tea districts in South India was made, further reference to which is made in the Annual Report of the Mycology Department.

Advisory.—303 letters on physiological subjects were received and 298 despatched.

TEA SEED.

Yields.—The records of young Khorijan jat seed-bearers summarized in earlier Annual Reports were continued during the year.

TABLE I
Yields from Seed-Bearers in 1946 and 1947

Year	No. of Bearers	Year First Bearing	SEED			
			Total	Sinkers per cent	Floaters per cent	Empties per cent
1946	14	1942-1944	4459	52	30	19
	16	1945	1344			
	28	1946	525			
1947	14	1942-1944	4490	45	43	12
	16	1945	1706			
	28	1946	1612			
	18	1947	612			

TABLE II
Percentage of Empty Seed

Jan.	Feb.	Mar.	April	May	June
20	19	17	9	13	7
July	Aug.	Sept.	Oct.	Nov.	Dec.
14	8	11	12	17	6

TABLE III
Percentage Crop Harvested Monthly
1947

Jan.	Feb.	Mar.	April	May	June
4.1	2.9	6.7	4.7	8.1	5.6
July	Aug.	Sept.	Oct.	Nov.	Dec.
2.9	9.3	13.3	14.0	13.4	15.1

The mean monthly percentage of empty seed in 1947 was 12.7 per cent (Table II), compared with 19.4 per cent in 1946 and 19.7 per cent in 1945. The monthly percentage of empty seed fluctuated less markedly than in earlier years. The distribution of yield seed during the year (Table III) was similar to 1945, with the major crop occurring between the months of August and December.

Data given in an annual report for 1938 show that, of the buds originally formed on a bearer, only an extremely small proportion mature into fruit. Any relatively small increase in the mortality of buds or flowers appearing at a given time would therefore have a relatively large effect when judged by the reduction in the relative number of fruit ripening at a later period. This may provide a partial explanation of the variability in the distribution of seed yield from month to month in successive years noted above.

TEA CLONES.

As stated in the Annual Report for 1946, the pruning programme for the clonal multiplication plots was re-arranged to allow of additional information being collected. The arrival of blister blight has materially altered the situation, however. Pruning during the South-West monsoon has been proved to result in disastrous damage to tipping growth, unless

routine spraying is undertaken. The pruning programme, therefore, has been re-arranged as follows:—

First series.—Pruned May 1946 on prior programme.

Second series.—Pruned May 1947 on prior programme.

Third (1948) and subsequent prunings.—

Centring young plants	November 15th.
Cutting across prior to 1st plucking	November, 15th
Pruning of old tea	November, 15th.
First tipping, young and old tea	January, 15th.
Second tipping, young and old tea	February, 7th.
Third tipping young and old tea	February, 28th.

The proposed comparison of the distribution of yield with age from pruning in different clones will not, therefore, be possible until the yields of the year November 1948 to November 1949 are available. The comparison then possible will be of the yields, under similar conditions, of bushes of each clone over periods from pruning of 0-12 months, 18-30 months and 30-42 months. If the new programme is adhered to, subsequent comparison of yields in first, second and third years from pruning, as originally intended, will be possible after 1949.

Characteristics of St. Coombs Clones.—In Table VII of the Annual Report for 1946 are shown the yields of all clones during the first six months of plucking of the series pruned in May 1946 (see above). In Table IV yields for the first twelve months of plucking are given, together with the percentage rooting obtained in 1946, and the percentage of cuttings, planted during 1947, alive and apparently successful at the end of December. It should be noted that of the clones under propagation, only those from mother bushes selected in 1946 and propagated in 1947 were specifically selected for ease of rooting. The percentages obtained from the better rooters are far higher than the average, and illustrate the desirability of selection of clones for this characteristic. Estates should concern themselves only with the best "rooters" which are otherwise satisfactory. Of the 1947 mother bush selections, half were discarded on the basis of the rooting records in the initial propagation. The subsequent establishment and growth of this series has been encouraging and again suggestive of a close relationship between ease of rooting and ease of establishment of young plants in the field. Those clones which fail to establish well will be replaced with additional rows of more satisfactory clones early in the 1948 planting season.

Resistance to Blister Blight.—The occurrence under field conditions of some bushes which, while not "immune" to blister blight, were nevertheless apparently far more resistant than the normal, and of other bushes conspicuously susceptible, was followed up by a careful examination of the susceptibility of the St. Coombs tea clones under comparable field conditions during the South-West monsoon period.

The collection of tea clones at St. Coombs had, naturally, not been selected originally for blister blight resistance and it was found to contain very susceptible as well as apparently resistant types. The early data on this subject were reported in the *Tea Quarterly*, Vol. XIX, Pt. II, July, 1947. Pre-occupation with advisory and field work upon the disease has prevented examination of the means by which certain clones achieve resistance, but it is apparent that blisters per bush, or even percentage of

TABLE IV
YIELDS—SERIES A

From 14th September, 1946 to 29th August, 1947

Clonal Series	No. of Bushes Plucked	Calculated Yields per acre	Order of merit (Yield)	Rooting per cent 1946	Rooting per cent 1947
1937/38					
1	11	510	9	36	82
9	6	910	4	16	57
13	10	415	13	18	76
14	9	495	10	30	74
15	10	725	7	30	68
16	9	460	12	22	69
18	10	875	5	42	71
19	10	495	10	24	64
21	8	940	3	28	74
222	9	875	5	22	83
23	9	990	2	46	63
25	9	1270	1	43	62
Seedlings	9	625	8		
1939					
4	10	645	4	28	82
32	9	280	6	24	54
33	12	395	5	0	48
37	8	955	2	39	67
45	9	1155	1	37	97
46	11	840	3	38	97
1941					
20	2	295	34	24	85
22	11	580	17	24	61
34	7	545	19	26	64
43	11	545	19	10	71
43	8	380	30		
128	11	510	22	47	83
216	11	745	11	40	66
216	12	510	22		
331	12	610	16	58	79
331	11	430	29		
343	10	530	21	12	35
397	11	280	35	22	47
407	11	580	17	36	96
483	10	345	32	19	92
510	10	510	22	36	97
603	11	725	12	50	94
777	11	1040	1	58	62
777	11	790	7		
839	12	510	22	36	96
928	9	660	14	34	48
934	10	1025	2	30	86
960	1	165	36	42	63

TABLE IV—(Contd.)

Clonal Series	No. of Bushes Plucked	Calculated Yields per acre	Order of merit (Yield)	Rooting per cent 1946	Rooting per cent 1947
1005	9	460	27	18	86
1016	8	460	27	42	73
1016	9	380	30		
1076	12	760	10	52	94
1082	11	890	4	36	92
1114	10	840	5	52	63
1294	12	825	6	70	83
1294	11	645	15		
1526	10	790	7	53	52
1526	10	925	3		
1530	11	775	9	73	44
1530	10	695	13		
Seedlings	11	495	26		
"	10	315	33		
1941/42 105	6	380	3	22	61
142	10	495	1	30	40
293	8	315	4	14	38
396	5	295	5	32	47
687	4	85	8	31	43
740	7	415	2	56	83
862	9	230	6	25	84
999	7	215	7	24	42
1943 170	16	330	7	6	79
235	19	295	10	21	67
384	13	265	13	10	
425	19	365	4	21	35
708	19	250	14	7	40
742	17	150	16	0	23
896	16	295	10	23	31
946	19	365	4	20	70
997	15	295	10	25	70
1000	20	200	15	2	13
1001	6	495	2	25	82
1054	20	345	6	21	
1118	14	315	8	10	21
1128	13	530	1	8	
1387	8	150	16	19	
1446	9	480	3	31	79
1456	17	315	8	23	81
1944 N1				0	71
N3				69	81
124				10	60
132				8	41

TABLE IV—(Contd.)

Clonal Series	No. of Bushes Plucked	Calculated Yields per acre	Order of merit (Yield)	Rooting per cent 1946	Rooting per cent 1947
S220				9	92
223				10	27
S255				44	51
S261				18	41
S265				25	72
769				42	68
789				40	71
1002				46	62
1544				10	27
1947 3				51	38
2005				69	43
2006				63	80
2007				57	71
2011				56	75
2012				52	88
2014				56	64
2015				59	59
2016				81	64
2017				68	26
2019				85	72
2020				59	76
2021				59	66
2022				57	74
2023				98	76
2024				78	77
2025				62	87
2026				64	68
2027				49	58
2031				46	49
2039				68	75
2040				63	59
2041				53	67
2042				60	54
2043				78	50
2044				77	66
2045				58	47
2046				68	43
2049				56	
2050				70	

TABLE V

Clonal Series		Mean blisters per bush per nine days	Blisters per unit crop over period	Order of merit	Blisters per unit flush	Order of merit	Mean order of merit
1937/38	1	1.3	16.86	4	.0740	5	4.5
	9	1.5	10.47	1	.0513	2	1.5
	13	2.7	38.55	7	.1652	8	7.5
	14	6.4	81.06	12	.2619	12	12.0
	15	1.9	15.02	3	.0624	3	3.0
	16	3.2	45.89	9	.1282	7	8.0
	18	2.6	17.63	5	.0678	4	4.5
	19	3.1	41.67	8	.1667	9	8.5
	21	1.7	10.76	2	.0441	1	1.5
	222	8.5	60.63	10	.1752	10	10.0
	23	3.8	25.66	6	.0799	6	6.0
	25	15.1	63.90	11	.2121	11	11.0
	Seedlings	11.6	115.56	13	.42.43	13	13.0
1939	4	1.3	12.45	2	.0379	1	1.5
	32	1.0	24.74	5	.0813	4	4.5
	33	0.7	11.62	1	.0384	2	1.5
	37	2.1	135.80	6	.4364	6	6.0
	45	4.2	22.81	4	.0922	5	4.5
	46	2.5	18.03	3	.0754	3	3.0
1941	20	0.3	4.58	1	.0229	2	1.5
	22	4.3	49.79	26	.1828	26	21.0
	34	2.2	24.67	16	.1077	17	16.5
	43 T55	1.1	12.86	10	.0449	10	10.0
	43 T36	1.7	28.37	17	.0831	16	16.5
	128	1.0	10.50	8	.0240	3	5.5
	216 T65	6.2	72.70	31	.3269	32	31.5
	216 T60	9.4	68.86	30	.2811	30	30.0
	331 T61	3.5	35.94	22	.1628	25	23.5
	331 T66	3.9	57.45	28	.2215	29	28.5
	343	3.1	35.66	21	.1269	21	21.0
	397	0.8	17.06	11	.0710	14	12.5
	407	0.7	6.75	2	.0199	1	1.5
	483	1.7	30.26	18	.1084	18	18.0
	510	2.8	36.31	23	.1309	22	22.5
	603	1.0	9.07	6	.0297	5	5.5
	777 T57	3.2	18.46	12	.0566	11	12.5
	777 T28	2.7	20.97	15	.0793	15	15.0
	839	2.5	31.01	20	.1222	20	20.0
	928	0.8	7.29	3	.0268	4	3.5
	934	3.3	18.90	13	.0620	12	12.5
	960	1.4	135.00	34	.4576	34	34.0
	1005	3.1	42.88	25	.1366	23	24.0
	1016 T59	0.8	11.34	9	.0307	7	8.0
	1016 T67	1.2	19.81	14	.0658	13	13.5

TABLE V—*Contd.*

Clonal Series		Mean blisters per bush per nine days	Blisters per unit crop over period	Order of merit	Blisters per unit flush	Order of merit	Mean order of merit
	1076	1.2	9.46	7	.0361	9	8.0
	1082	11.3	81.05	32	.3308	33	32.5
	1114	8.4	60.80	29	.2057	28	28.5
	1294 T50	30.6	245.10	35	.5741	35	35.0
	1294 T64	30.0	310.85	36	.7457	36	36.0
	1526 T31	1.0	7.34	4	.0301	6	5.0
	1526 T47	1.1	8.12	5	.0316	8	6.5
	1530 T30	3.3	30.38	19	.1179	19	19.0
	1530 T48	4.2	37.65	24	.1442	24	24.0
	Seedlings T29	3.7	53.29	27	.2053	27	27.0
	Seedlings T35	3.8	84.18	33	.3097	31	32.0
1941/42	105	1.2	19.17	2	.0717	2	2.0
	142	2.6	32.24	4	.1329	3	3.5
	293	3.2	66.45	6	.1922	6	6.0
	396	1.4	30.43	3	.1361	4	3.5
	687	1.5	150.00	8	.3871	8	8.0
	740	0.4	6.78	1	.0218	1	1.0
	862	2.8	84.24	7	.2734	7	7.0
	999	1.6	52.09	5	.1735	5	5.0
1947	170	0.4	8.45	6	.0352	7	6.5
6	235	0.3	7.34	3	.0224	3	3.0
	384	0.8	23.52	12	.1031	13	12.5
	425	0.2	4.57	1	.0184	1	1.0
	708	0.7	7.76	4	.0240	4	4.0
	742	0.2	8.35	5	.0256	5	5.0
	896	1.9	46.58	15	.1554	15	15.0
	946	1.9	41.29	14	.1169	14	14.0
	997	0.6	16.60	11	.0549	10	10.5
	1000	0.8	33.57	13	.1027	12	12.5
	1001	0.8	12.05	8	.0398	8	8.0
	1054	0.7	16.32	10	.0599	11	10.5
	1118	4.4	98.94	17	.3700	17	17.0
	1128	0.5	8.52	7	.0331	6	6.5
	1387	1.5	79.78	16	.1607	16	16.0
	1446	0.8	15.56	9	.0513	9	9.0
	1456	2.5	6.82	2	.0202	2	2.0

bushes infected, provides but a rough measure of resistance. Since shoots are plucked before blisters become easily apparent, the blisters seen on bushes in plucking are, apart from *arambu* infections, developed on the "3rd leaves" left on the bush by the plucking operation or on other young growth below the plucking table. Since no measure of this growth is, in practice, available over long periods, Table V has been based on the assumption that crop removed is a measure of the young growth left on the bush for sufficient time to develop visible blisters. The "order of merit," as regards resistance, has been calculated both on the number of blisters per unit weight of crop and per unit number of flush. The mean of these provides the most satisfactory field measure of resistance at present available and gives some guide to further selection. It must not be forgotten, however, that yield still remains the essential criterion. Thus clone 1114 was, nevertheless, a good yielder in 1947 (Table IV) in spite of its relative susceptibility. Of the pre-1947 selections, a clone apparently combining high levels of quality, yield and blister resistance is No. 1526.

Selection of mother bushes on the basis of apparent resistance to blister blight was carried out during 1947 in a field badly affected after pruning in April 1947. No immune bushes were discovered, all having undoubtedly been checked by the heavy infections that occurred during the budbreak stage. Thus there is little chance of a genuinely "immune" clone emerging from the present series. Out of nearly 49,000 bushes, 211 were marked as a result of careful examination of individual bushes. These were finally reduced to 21 bushes on which traces of lesions were absent or extremely few at the time of examination. These provide the basis of a new multiplication area planted out in 1947, which includes eighteen further clones received from estates, and believed to be blister blight resistant, together with three of the older series (1526, 777 and 1114) for comparative purposes. In view of the urgency of the matter the multiplication plot was directly planted up with cuttings, the opportunity being taken to include a comparison between long and short cuttings. These cuttings received the same treatment as regards watering, etc., as those of the same clones planted out in the propagation nurseries themselves. Such direct planting up is not recommended as a normal procedure.

Manuring.—An experiment to allow of the comparison of the effects of applying varying amounts of soluble manures in occasional large doses or in frequent small doses was commenced during the year. For this purpose cuttings of eight clones (23, 37, 216, 777, 928, 1114, 1294 and 1526) planted between 15th July and 7th August 1947 receive manure at the following rates per annum per acre of *bed surface* commencing five months after planting.

		A.	B.	C.
N	...	50 lbs.	75 lbs.	100 lbs.
P ₂ O ₅	...	30 lbs.	45 lbs.	60 lbs.
K ₂ O	...	20 lbs.	30 lbs.	40 lbs.

Treatments A, B and C are sub-divided, proportionate applications of manure being applied either every two weeks or every ten weeks. Thus in addition to providing information as to the most effective level of manur-

ing, the experiment will provide information as to the extent to which it is desirable to carry the policy of "little and often" in the case of different clones.

PRUNING.

In April 1947 a preliminary experiment was commenced at St. Coombs to collect data upon the effects of pruning at different months of the year in relation to Blister Blight. The results were sufficiently striking to justify the continuance of the observations on a rather more elaborate scale in a fresh experiment set up in January, 1948. The overlap is designed to allow of some degree of continuity.

The results of this and of other experiments during 1947 leave no room for doubt that light cutting across offers no substitute whatever for pruning at a time that permits of "dry weather recovery from bud-break onwards." The most that can be said is that, where monsoon pruning is adopted contrary to all advice, lighter pruning partly reduces the very serious damage that may result.

Experience during the year has borne out the warning given at the 1947 Tea Conference that the arrival of blister blight has increased the risk of damage to the bush resulting from deficiency of carbohydrate reserves. Death and dieback after pruning from exhaustion of these reserves have been common where such pruning has been indulged in, and only the exceptionally dry and sunny weather experienced during the North-East monsoon prevented severe damage resulting from pruning too early in this monsoon in the South-West districts. It is to be hoped that the experimental results referred to above may convince those who contemplate such a gamble once again.

The maintenance of an adequate leaf area on the bush has now become a factor that requires consideration throughout the cycle. The amount of leaf present on the bush depends upon its rate of loss of old leaf and the rate of formation of new leaf. Loss of old leaf commences about 12 to 18 months after pruning, and is enhanced by drought and by dry or heavy winds. Its effect is to give a 'thin' appearance to the bottom of the bush. In the absence of blister blight this is partly compensated for by the production of leaf on banji shoots produced on the edge of, and within, the bush. During conditions favourable to blister blight such shoots are destroyed at an early stage, and the general result has been to increase considerably the 'thinness' of bushes up-country.

The reduction of leaf surface thus caused can only be aggravated by a policy of close plucking throughout the year, and of tipping fields so close to the pruning level that shoots "tipped" below the pruning level may often be discovered. The contribution that labour conditions make to such undesirable results must not be allowed to disguise the fact that they may add considerably to the strain on the reserves of the bush caused by blister blight. While not going here into the merits of "close" versus "light" plucking as a general practice, it is necessary to emphasise that whichever system is adopted a leaf area sufficient to maintain the bush and produce its crop must be maintained if damage is to be avoided. Again, "early" tipping can be carried out as shoots reach four, six and even more inches above the pruning level. Except in the case of bushes cut across above the tipping level of the previous cycle, it is recommended that no tipping lower

than four inches in low jat fields and five in high, be carried out. Reference to the proceedings of the 1947 Conference and subsequent articles in the *Tea Quarterly* for 1947 may be made.

Where bushes have been badly damaged soon after tipping by blister blight little leaf may be formed until the ensuing dry weather. It is recommended that all such fields be rested for three or four rounds towards the end of the dry weather, and plucked in to a higher level six weeks to two months before serious blister is likely. In the south western districts this involves completion of the resting by the end of March at the latest. Such treatment should also be applied to weak individual bushes which lack a good cover of leaf in otherwise satisfactory fields.

Individual bushes sometimes take a considerable time to recover from pruning and may be ready for tipping after normal bushes are in full plucking. Such bushes should not be tipped lower than the height to which the bushes in plucking have by then attained, in order that an amount of leaf more comparable to that of normal bushes may remain on the treated bush.

PLUCKING STANDARDS.

Considerable interest in plucking standards has been aroused by the deterioration in labour discipline, and by the impact of poor leaf on factory technique. The results of a comprehensive and long continued examination of the problem have been collected and will appear in the *Tea Quarterly* 1948.

GREEN MANURES.

During the course of the visit to South India referred to earlier, seed of *Crotalaria grahamiana* was collected in the High Range and Devershota. The growth of this species at St. Coombs has proved to be rapid, while the stems remain soft for a longer period than with other *Crotalaris*. The stock is being multiplied and seed will be distributed in small quantities as it becomes available.

Selection of *Crotalaria anagyroides* and *Tephrosia vogelii* was continued during the year, seed plants being selected from the progeny of the initial selections made in 1946. In the case of *Crotalaria anagyroides* a relatively high degree of superficial uniformity and vigour has been obtained, but many generations will be necessary to fix these characteristics. With a view to assisting in the present period of shortage of green manure seeds, small quantities of seed have been distributed for the growth of seed-bearers to a number of estates. A third generation of seed-bearers has already been planted at St. Coombs and seed from these will be available from January 1949 onwards.

In the case of *Tephrosia vogelii* the relatively slow growth compared to *Crotalaria anagyroides* has proved to be most marked. The second sowing of both species was carried out on 6th May. The seedling growth of the latter species was much more rapid, the initial collection of seed taking place in January 1948. At this time the *Tephrosia* plants were much smaller and were only just coming into flower.

The flowering time of *Tephrosia vogelii* varies considerably from plant to plant. There appears to be three strains, grading into one another. The plants that flowered first ripened seed in ten months from sowing, the intermediate type in the same period only produced flowers while the 'shy flowering' types exhibit no sign of flower. Ordinary methods

of seed production on estates where no selection of the seed parents is carried out will naturally favour the free-flowering, early-ripening types. In an attempt to reverse the process, the experimental seed parents have been reduced to the late flowering type and future selection of *Tephrosia vogelii* will be carried out on their progeny only. The flowering of *Crotalaria anagyroides* has not so far exhibited such marked individual differences between plants.

BUSH NUMBER PER ACRE.

A survey of the bush number per acre on St. Coombs provided unexpected results. The bush number per acre should theoretically be higher than that calculated from planting distance, since the acreages are all based on the plane projection of the actual land surface. In fact, however, paths, drains and vacancies, even where the latter are few in number, reduce the actual bush number below that to be expected even were the land flat. Thus on St. Coombs the average bush number per acre is only 2,986 excluding the two contour areas and No. 1, which was planted amid coffee and has no definite spacing. A contour area planted 5 by 1½ has only 4,670 bushes to the acre. These figures were based on a bush by bush count and suggest that the bush number on poor, or widely spaced, areas may be startlingly lower than expectation.

CONCLUSIONS.

The writer desires to acknowledge very warmly the kindness and consideration he has always received from all concerned with the Industry throughout his work in Ceylon.

F. R. TUBBS,
Plant Physiologist.

REPORT

OF

THE BIOCHEMIST

FOR 1947

Staff.—Dr. H. B. Sreerangachar resigned from the Staff of the Institute and left Ceylon on 5th March, 1947. Dr. Sreerangachar has accepted an appointment with Messrs. Sarabai Chemicals Ltd., Baroda, India, and we wish him success in his new post. Having worked continuously on the biochemistry of tea since 1930, when he first joined the Institute Dr. Sreerangachar had accumulated a fund of experience which cannot readily be replaced. The progress of our work on the biochemistry of tea will therefore receive a serious check. With only one specialist working on this complex subject such checks are liable to occur from time to time and are, an inherent disadvantage of a severely limited staff.

The Biochemist has too wide a field of activities to carry out fundamental biochemical work without an experienced assistant and experience cannot be transferred from one assistant to another.

Fortunately, with the much appreciated aid of Professor Subramanyan of the Indian Institute of Science, Bangalore, we were able to obtain the services of Mr. M. S. Ramaswamy, B.Sc., A.I.I.Sc. Since graduating, Mr. Ramaswamy has had some general and research experience and has worked on enzyme problems which is a particular qualification for work on tea biochemistry which has so far been mostly concerned with enzyme systems. Mr. Ramaswamy quickly settled down in the laboratory and we hope to investigate some of the factors concerned in the development of flavour in tea. It will, however, take Mr. Ramaswamy a considerable time to acquaint himself with the chemistry of tea leaf. A problem concerned with the coloured pigments occurring in some varieties of tea will however afford him an opportunity for acquiring experience in the field.

Correspondence.—419 letters were received and 400 were despatched.

Advisory.—The state of the tea market has always controlled the activities of this department on advisory work. During the contract period advisory work on tea manufacture accounted for a very small part of the total activities of the Department and when the Biochemist returned from war service the Department was able to carry out almost uninterrupted research work on both fundamental, biochemical and technical manufacturing problems. Immediately after the war there was a marked increase in correspondence and a very large number of visitors came to the Institute. As soon as the Colombo market opened and began to discriminate between teas offered for sale, advisory work of this Department increased by leaps and bounds. Apart from what must be a record number of visitors to the factory, advisory letters and visits increased suddenly to pre-war levels

From 1940 onwards the number of outward letters was under 200 per annum except for 1945 when the number rose to over 400 on account of the unfortunate publicity given to the P.F.C. process. During 1947 the number of outward letters was again over 400, the greater proportion of which required considerable preparation, and many manufacture programmes and drawings of E.P. rolling fittings which take a considerable time to prepare. Carefully thought out programmes of manufacture for a large factory may occupy an assistant for a whole day.

Mr. E. L. Keegel actually spends more time now at his desk than in the factory carrying out experiments.

In my report for 1937 I pointed out that it would be necessary to restrict factory visits if the Department was to function normally and avoid the whole time occupation with advisory work which my predecessor, Dr. Evans, found most unsatisfactory.

During 1947 seventeen factories were visited on major advisory problems and since each such visit takes at least a whole day, sometimes two or three, and another whole day is usually occupied in examination of samples (mainly numerous moisture content analyses), writing the report and drawing up programmes, etc., it will be readily understood that the amount of such work which can be undertaken is very limited. In making a request for an advisory visit it is of the greatest assistance when the fullest possible details of manufacture are sent.

BIOCHEMICAL.

Coloured Pigments.—The coloured pigments Anthocyanins and Flavones occur in a number of varieties of tea which may frequently be seen in the field as yellowish or red leaved hybrids. The flowers of the tea bush contain flavones. As previously reported, one particularly highly coloured variety, the leaves of which are deep red (T. 26), has been propagated by the Plant Physiologist to provide sufficient material for investigation of this pigment.

Last year it was reported that Dr. Bradfield working under the Chemistry of Tea investigation in London had shewn that the principal constituent of tea leaf are six catechins of varying composition. The anthocyanins and flavones are very closely related to the catechins and account for the majority of the colours of flowers relatively small differences in composition causing the variations between Reds, Yellow and Blues.

The nature of the red and yellow pigments occurring in tea are therefore of considerable interest. During the course of the year it was noticed that the fungus causing Blister Blight has the power of converting flavones into anthocyanins and bushes containing marked amounts of flavones thus bear red instead of white blisters when attacked by blister blight.

After some difficulty a red pigment believed to be fairly pure has been isolated. As the exact composition of this red pigment has not been established and since the work has not yet been reported in a scientific journal this opportunity is taken of publishing an outline of its properties.

1. Solubility. The pigment is soluble in water, alcohol and acetone giving a clear, deep red solution. It is insoluble in chloroform, ether and ethyl acetate.
2. A dilute solution of sodium carbonate causes the pigment to assume a deep blue colour which changes to green with excess of the reagent.

3. A solution of ferric chloride gives a bluish-violet colour.
4. A solution of neutral lead acetate gives a blue precipitate.
5. The slight solubility in iso-amyl alcohol indicates a glucosidal form.
6. A dilute solution fades in a few minutes and becomes colourless but the red colour returns on acidification.
7. The pigment is unstable in solution or in the solid form when exposed to air.
6. It has not been possible to crystallise the pigment or to dry it completely. The preparation could only be partly drier over phosphorus pentoxide *in vacuo*.

Enzymes.

1. The possibility of sending purified polyphenol oxidase preparation to other research workers was investigated. It was found that purified preparations lost about 20 per cent only of their activity in 14 days when stored in a refrigerator. It should be possible to send active preparations by air mail.
2. Relation of polyphenol oxidase activity to quality, Clones giving high and low quality liquors did not appear to vary in their oxidase activity.
3. Preliminary investigations of esterases shew that a Pectase which demethylates pectins is active during fermentation and may well be an important factor in fermentation.

Riboflavin (Vitamin B2) in Tea.—During the war it was discovered by a food investigation in the United Kingdom that tea and bear were considerable sources of Vitamin B2 which made a valuable contribution to the balance of diet in certain classes of workers.

Bradfield and Hughes of Messrs. J. Lyon & Co.'s laboratories carried out further investigations of made tea and using their method we have extended the investigation to details of manufacture of Ceylon tea. It is intended to publish these results in a scientific journal and the following figures are given as a general indication of our results.

All the figures given are in μg per gram dry weight.

Liver	...	...	40-70 $\mu\text{g/g}$
Yeast	...	...	35-40 "
Fresh leaf	...	...	16-18 $\mu\text{g/g}$
Withered leaf	...	...	18 "
Dhools and bulk	...	...	16 "
Fired tea	...	...	16 "

It is estimated that 80 per cent of the vitamin in the dry leaf passed into the cup when the tea is brewed in a teapot. Teas which had been stored for a year shewed practically the same content as fresh teas.

The Vitamin B2 inherent in tea leaf is therefore largely available in the beverage as consumed.

Volatile Matter.—The development of the characteristic odour or "nose" during fermentation and the strong aroma in and around a tea factory strongly suggest the presence of volatile matter in fermented leaf.

An attempt to measure the amount of material volatile in steam was reported in 1945 but it was soon discovered that the total volatile matter bore no relation to quality since low-country teas tended to give higher values than high grown leaf. However, an investigation has in the beginning to accept facts as they are discovered and it is too early to distinguish between quantity and quality. The amounts and variations of steam volatile matter in tea leaf are of basic interest and have been studied in some detail.

Many months were spent on developing a reliable method of estimation and during the course of this work it was found that the leaf whether fresh or manufactured must be very finely ground before steam distillation. Much of the volatile matter measured by this method appears to arise from the pectin content of the leaf and an enzyme (pectase) is concerned in the changes which occur during fermentation and which cause an apparent loss of volatile matter.

The following figures are typical of the changes measured during the course of manufacture. The figures expressed are ml. of fifth-normal potassium permanganate related to 100 gms. of dry matter in the leaf.

Green leaf	... 84	Withered	... 71
Crushed	... 76	Crushed	... 58
Fermented for 1 hour	... 63	Fermented for 1 hour	... 49
Fermented for 6 hours	... 47	Fermented for 6 hours	... 43
Fired at 1 hour	... 29	Fired at 1 hour	... 25
Fired at 6 hours	... 21	Fired at 6 hours	... 20

The variations between different leaf samples is very marked and is possibly associated with varying pectin contents. It has previously been shewn that the pectin content of tea leaf is very variable.

ANALYTICAL.

Copper Content of Tea Leaf.—In view of the association of copper with the enzyme (polyphenol oxidase) associated with fermentation the copper status of tea bushes is a matter of some interest.

It is intended to carry out a limited survey of Ceylon tea to investigate copper status. Preliminary experiments have been completed and the following figures show the variations encountered amongst bushes of widely different character grown in the same area.

Bush	Copper content of flush (mg/grm.)		
R4P7	...	...	20.6
R2P7	...	...	16.2
R3P3	...	...	30.5
R2P3	...	...	19.4
R1P3	...	...	24.0
R5P3	...	...	29.2
R6P3	...	...	22.8

R2P7 is a type of bush, the flush from which shews little or no fermentation on crushing.

MANUFACTURE.

Epicyclic Pressure Rolling.—The major part of the experimental work in the factory was devoted to Epicyclic-Pressure (E.P. rolling) because it is of immediate economic importance.

We have repeatedly advised caution in conversions to E.P. rolling and the soundness of this advice has been borne out by events during the year. During the period of contract sales to the United Kingdom, standards were relaxed and we have frequently pointed out that E.P. fittings giving satisfactory results during the contract period may not suit an open, discriminating, market. In any case the Colombo market before the war demanded a very high standard of appearance which was far higher than the average maintained for teas purchased on contract.

As soon as the first rush of buying on the newly opened Colombo market was over and Buyers began to discriminate to some extent, we began to receive requests for advice and help in cases where E.P. fittings were not giving satisfactory results. By the middle of the year when as reported under the "Advisory" section of this report, our advisory activities had returned to pre-war levels, this was largely due to troubles with

E. P. rolling.

In some factories conversion to E.P. rolling had undoubtedly saved labour and machinery and so long as it gave satisfactory results during the contract period its use was fully justified. In other cases, however, conversions were not justifiable on these grounds and have probably resulted in a definite loss in prices in 1947. As soon as any new idea for tea manufacture is mooted there is a widespread urge to adopt it before it has been fully tested on even a small commercial scale. It would also appear that far too many patents are taken out purely on a chance that an idea may work but without any proper assessment of the factors involved.

The tea industry is far too conservative for any new idea to be adopted "overnight" and it would save much trouble and unnecessary expense if estates would allow ideas and machines to be proved before considering their adaption and if patentees would pursue their studies under working conditions for a period sufficient to establish reliability before taking out actual patents.

Difficulties have arisen with both "home-made" and patented fittings and in some cases attempts to improve results have led to reduction of charges and slowing down rollers to the point where the principal advantage of E.P. rolling is lost.

E.P. rolling is primarily a method for improving efficiency. There are no grounds at present for regarding it as a method of making better teas. With properly designed fittings it is possible to turn out (with the possible exception of O.P.) teas equal to those produced on batten pressure cap combination with the following advantages:—

1. Three rolls only as compared to the usual four or five rolls on batten/pressure cap rollers. There is every indication that 20 minutes rolls may be satisfactory.
2. Open top jackets which greatly facilitate charging.
3. Elimination of pressure cap manipulation.
4. Elimination of throw-out by reducing the clearance of the jacket from a plain table.
5. Small big-bulk percentage,

In general, E.P. rolling does not appear a very suitable method for making Orange Pekoe. We must however point out that our experience in the low-country is very limited and by adjusting fittings to give a high percentage of big bulk it may be possible to make satisfactory O.P. from low-country leaf. In all our experiments we have regarded O.P. as a grade for which there is a very limited demand and have so far ignored it.

The advantages referred to above make it possible to double the output of leaf per roller and per rolling room labourer at least when compared to a five roll programme. Normal charges may be employed if the fittings are properly designed. Naturally, if the charge per roller has to be reduced one of the main advantages is lost.

Until tea markets become stabilised it will be difficult if not impossible to reach any very definite conclusions on the merits and demerits of E.P. rolling. We have therefore hesitated to publish the results of our experiments until we are quite certain of our facts. Meanwhile the following summary indicates the general outlines of our findings:—

1. So far as the design of fittings is concerned the primary requirement is that there must not be any sharp edges on the fittings to cut or tear the leaf and the epicyclic pressure employed must be as low as possible. In other words long thin fittings are preferable to short and fat ones. This consideration is limited by the fact that the dhool producing capacity of a vertical fitting falls as the distance from the table increases and beyond seven inches is very small. Also the higher the vertical fittings are made, the greater the leverage and strain on the door and its fittings. We are therefore standardising the height of the dhool-producing parts of the fittings to seven inches.
2. As reported previously (1946) success or failure depends on the first roll during which period a satisfactory twist must be produced. This first roll fitting must be of a special design developed to give the maximum twist. Experiments were carried out using battens and pressure cap for a first roll followed by two E.P. rolls and comparing this with three E.P. rolls. Tasters preferred the teas which were first rolled on battens under pressure mainly on appearance. The design of the first roll E.P. fitting was accordingly modified.

Experiments with a plain cone giving a very low first dhool were unsatisfactory. So long as the angles subtended at the base of a plain cone are below 45° it produces no epicyclic pressure but if the cone is fairly high (5" on a 36" roller) it induces a brisk circulation. A plain cone moving round a roller jacket lifts the leaf on the inclined surface and is bound to give a good circulation. We now strongly recommend a plain cone for use in conjunction with battens, details of which are given later. However, so long as this inclined face of the cone approaches the table at an angle of less than 45° the pressure exerted on the leaf is resolved into a vertical direction and must be met with a pressure cap. Circulation alone does not produce a satisfactory twist. Rapid circulation will rapidly twist up the leaf but the twist is an open one and not tight enough to wring out the juice from the leaf. When the circulation takes place under pressure the twisting action is much more effective and produces a tight twist. The weight of leaf in the roller will also

create a pressure at the bottom of the jacket and leaf circulating under this pressure takes a tighter twist than leaf circulating in a very lightly charged roller. Normally, however, it is not possible to charge sufficient leaf to allow free circulation and at the same time create its own pressure. Leaf therefore must circulate under applied pressure if the twist is to be satisfactory.

On the other hand the applied pressure must not be too high or else the leaf breaks up too quickly and becomes so small that it is no longer possible to apply a wringing action. Such a pressure can be applied by a pressure cap.

The problem was therefore to obtain circulation and the right degree of pressure to obtain a tight twist using epicyclic pressure instead of "pressure cap" pressure. Normally, if the E.P. fitting is small and gives a low degree of pressure the leaf does not circulate properly with a normal charge.

It is possible to use a steep cone the sides of which subtend an angle of greater than 45° to the table but to obtain any degree of pressure the side must be fairly steep and this makes the fitting very tall and cumbersome. The base must be large otherwise adequate circulation is not obtained. We therefore superimposed an epicyclic pressure generating fitting on a conical base as shown in Fig. 1 and thus obtained circulation under light epicyclic pressure.

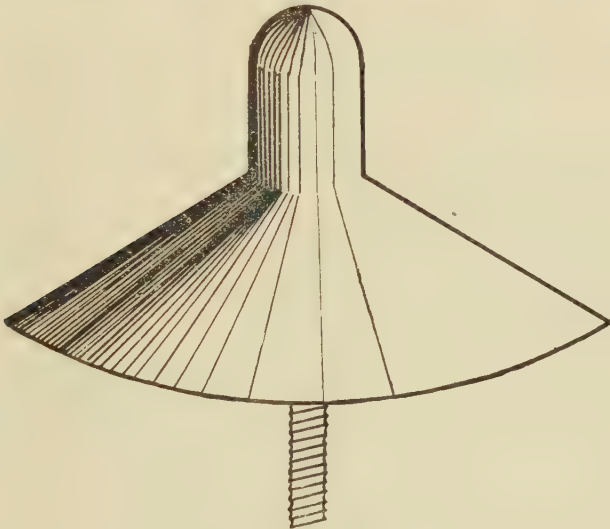


Fig. 1.

It has been found possible to obtain a very satisfactory twist with a fitting of this type and dimensions for all the common sizes of roller are being worked out. In cases where estates are anxious to make conversions we can supply drawings of suitable fittings but details will be published in the *Tea Quarterly*.

3. In second and third rolls where the epicyclic pressure is increased to produce dhool, the combined effect of the small gap and larger

fitting is sufficient to exert a thrust on the whole charge and thus to induce a brisk circulation. With a correct design every particle of leaf should pass through the pressure gap once every 30 seconds and each time receive a hard squeeze. A conical base or "apron" is therefore unnecessary in second or third rolls and the simplest epicyclic-pressure generating figure is employed, namely a cylinder, the top of which is rounded to avoid cutting edges as shewn in Fig. II.

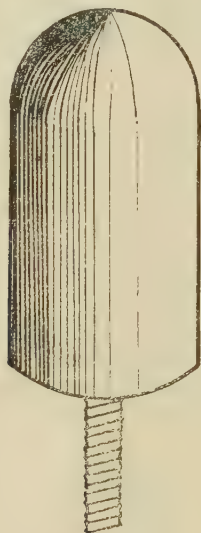


Fig. II.

The actual size of the fitting depends on the charge and the dhool required.

4. At heights above seven inches from the table the pressure generated by the vertical face of any of these fittings is very low. The conical base in the first roll fitting, by lifting the vertical face, also serves to reduce the pressure and therefore limits the pressure sufficiently to produce a tight twist without breaking up the leaf.

By limiting the height of these fittings the leverage is reduced and also the drag so that they can safely be fitted on an ordinary door without any reinforcements. A single belt of $1\frac{1}{4}$ in. diameter is sufficient for fixing any of these fittings.

A belt driven roller will also stop and start up again under full load with any correctly designed fitting.

Epicyclic pressure tends to "bell" the bottom of a roller jacket and a reinforcing band round the batten of the jacket is desirable.

5. All the fittings designed at the Tea Research Institute have been developed for use of normal charges and speeds.

The charge employed is an important factor in obtaining twist in the first roll and also governs the dhool out-turn. Standard charges must therefore be *weighed* for the first roll and the rollers used in the same order employing the correct fittings for second

and third rolls. If roller charges are combined for a third roll a smaller fitting will be required than when the rollers are employed in the order 1, 2, 3.

Reduction of the roller speed reduces dhool production, and in this case larger fittings, generating higher pressures, must be employed compared to a roller running at a normal speed (40-50 r.p.m.) Above 50 r.p.m. (range 50-78 r.p.m.) the power consumption increases with a relatively small increase in dhool production. Under carefully controlled conditions the teas produced by a roller running at speeds of 32, 48 and 78 r.p.m. were not distinguishable to Tea Tasters.

6. A further degree of freedom from tearing may be obtained by allowing the fittings to rotate freely. Although all the fittings we have employed have smooth rounded surfaces any body projecting into a mass of leaf and being forced to move in that mass with a stirring action is bound to cause some tearing action. If free rotation of the fitting is allowed most of its dragging action is thereby eliminated and it will move through the mass of leaf in a roller jacket with less tearing effect.

This particular development requires a great deal of further research and also engineering facilities beyond our scope. Free rotation of fittings reduces dhool out-turn and all dimensions then have to be reconsidered for all sizes and types of roller. Cooperation with an engineer is essential and as Mr. F. R. Noyes of Messrs. Davidson & Co. is interested in this development we have agreed to co-operate with him. Messrs. Davidson & Co. are producing the fittings we require for our experiments at the Tea Research Institute.

Nomenclature.—As a true cone appears to be quite useless on its own the discussion of rolling methods would be simplified if the term "cone" rolling were abandoned and the general term E.P. (Epicyclic pressure) applied to the method. The various forms of apparatus are best described as "Fittings" and specified as Colombo Commercial Co., Davidson & Co., F. R. I. or any patent name such as Column-Pressure or K'bakra fittings.

An additional reason for this is that a true cone used in conjunction with battens is a valuable aid to circulation as described in the next section.

Batten-Pressure Cap Rolling.—In batten pressure cap rolling the central portion of the table is still the effective zone of action and accounts for most of the dhool production. If any part of the central portion is raised its movement lifts the leaf and assists circulation. Any vertical facets or sharp edges in this zone may have a very severe cutting action.

Under pressure, if the central portion is flat, and not raised, the leaf in the jacket forms into a solid cake and drags over the surface formed by the battens caked with dhool. If a cone is fitted on the door its movement round the jacket is bound to lift the leaf on the leading face against the pressure of the pressure cap and to maintain some degree of circulation. Any batten system which is compatible* with a conical fitting on the door will be improved in twisting action by a cone on the door. The base of the cone should clear the jacket by one inch and the apex should be approxi-

* *i.e.*, Battens such as the "Crescent" or "Lamont Michie" which terminate at the door. Experiments are proceeding with the adaption of conical centres to other types of batten.

mately five inches above the table level. The top should be slightly rounded as shewn in Fig. 3. The angle A must not exceed 45° .

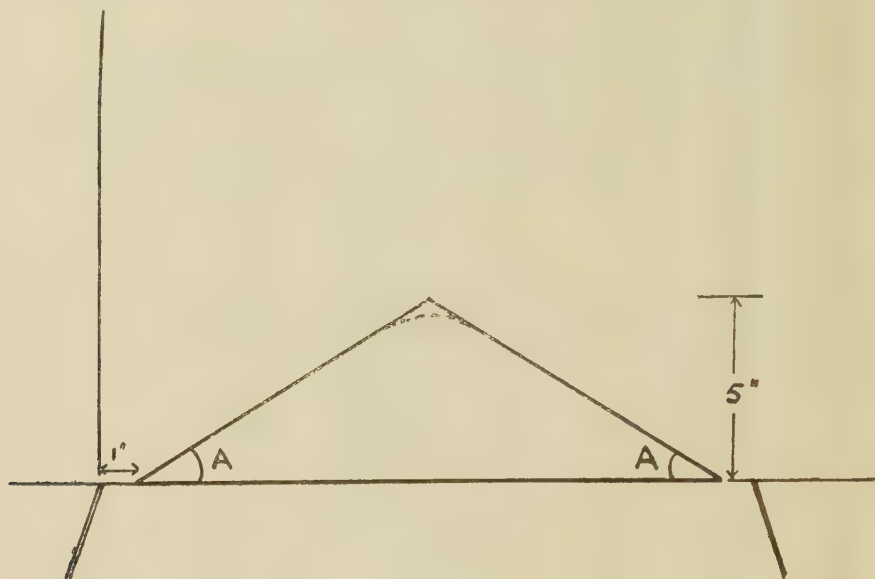


Fig. III.

Long-Term Experiments.—The opening of the Colombo market has led to a very strong demand for orthodox teas but Blenders in the United Kingdom, who might be disposed to accept teas of less orthodox appearance if the liquoring quality is good enough, have been forced to obtain their supplies through bulk buying. There has not therefore been any chance of testing out, under favourable conditions, any simplified methods of manufacture on a commercial scale. Experiments have continued and a new machine for treating green leaf is under construction in Colombo.

Mr. Napier Ford, as reported last year, has very kindly loaned to the Tea Research Institute a small Legge Cutter and experiments with this machine have been carried out during the year. Little real progress can be made however until experimental invoices can be sold on a market where U. K. Blenders have an opportunity of buying.

There is a possibility that tea bags may afford an outlet for strong liquoring teas of unorthodox appearance. Developments depend on the successful outcome of experiments with the teas in countries where the tea bag is acceptable.

A good deal of experimental data on the direct manufacture of green leaf have been collected and the fundamental principles have been worked out to a large extent.

The full scale commercial adoption of such methods, should developments in the tea trade prove favourable, will however bring us up against problems with which we are not equipped to deal.

The Institute urgently requires a workshop and may eventually have to appoint an engineer to its staff if progress with the developments of new

methods of manufacture is to be maintained. Technical development and commercial application are two entirely different problems which must not be confused in future plans.

MISCELLANEOUS EXPERIMENTS.

Single Roll Manufacture.—The advent of E.P. rolling with its free circulation of leaf and relatively cool conditions raises the question as to whether a number of rolls with a roll breaking operation between each roll is really necessary.

An experiment was devised to compare a three-roll programme, removing dhool between each roll, with one in which dhool was measured but returned to the roller.

Roll		Dhools removed Dhool %	Dhools returned Dhool %
1	...	13	14
2	...	31	41
3	...	42	37
B.B.	...	8	6

The grading percentages were as follows:—

		Dhools removed %	Dhools returned %
B.O.P.	...	56	45
Fannings	...	13	25
Pekoe	...	7	6

The dhools were evidently further reduced in size during the continued rolling. Tasters reported that this resulted in a loss of point and quality with a gain in colour. Leaf was brown and flaky.

This experiment appears to justify the practice of roll breaking but it is possible that a modified technique of rolling adapted to suit the one continued roll would overcome the loss of quality and appearance. Experiments will be carried out to test this possibility.

Acknowledgments.—The Biochemist wishes to acknowledge all the help given by Tea Tasters throughout the year. The tasting of experimental samples takes much more than the usual amount of time and we are very grateful to those tasters who, although taxed by pressure of work from large sales, give us all the assistance we ask for.

J. LAMB,
Biochemist.

REPORT

OF

THE SMALL-HOLDINGS OFFICER

GAMPOLA

FOR 1947

The work done during the period under review consisted mainly of a competition organised amongst the small-holders in tea in the Yati-Nuwara area. This was the first competition organised there since the war. The last one held in this area was in 1937.

Competitions of this nature help considerably to put added keenness into the work done by small-holders on their holdings. There have been entries from every *Wassama* (Minor Headman's area) in Yati-Nuwara, thus spreading this work of ours through the Division. These competitions are spread over a period of twelve months, enabling competitors to carry out the necessary improvements according to instructions. During this period regular visits are made to these villages, advice given and demonstrations carried out and every possible assistance given for the working of these small-holdings on correct lines. Special visits are made when there are requests from small-holders and any particular difficulty attended to

Special attention has been paid to Pruning which is more or less carried out under my personal supervision, the "Rim-Lung Prune" being always advocated. In recent times the pruning on all small-holdings has improved considerably and a majority adopt "Rim-Lung," while a few adopt the "Cut-Across merely with the object of getting a quick return. Small-holders have realised that the "Rim-Lung" reduces considerably the 'deaths' and the "dieback" after each pruning and that recovery has been hastened.

The draining has also improved considerably on small-holdings and a majority have very good drains.

The growing of green manures which has become quite a practice with small-holders has now become a problem with the new disease "Blister Blight." The small-holders' tea has suffered considerably from this new disease.

There were 204 competitors from the division, an average of 8 holdings from each *Wassama*. Competitions of this nature are, I find, a great incentive for work.

I am very grateful to the three Village Committees in this division for their very willing co-operation and for providing part of the funds for "Prize Money."

Advisory Work.—Though my work was centred round this one division, several visits were made to Uda-Nuwara and Uda-Palata, where advisory work was carried out on a number of holdings.

Fertilisers.—Small-holders have realised the value of using artificials and a number of applications were received and manure purchased through me. The good prices paid for green leaf right through the year has also helped in this direction.

Green Manure and Shade.—The small-holders now take readily to this for two very good reasons, as stated in my previous report. But heavy shade from these green manures which are not lopped regularly and kept under control helps the spread of this new disease in the tea during the monsoon.

Temporarily I am now trying to discourage the excessive growth of these green manures on the holdings itself, but to get holders to grow these on their boundary fence. This should give them all the green manure they require for using on their holdings and help to establish a definite boundary to their lands, which in a number of cases is always in doubt. This leads to the normal quarrels of "encroachment."

I have my doubts about small-holders growing their Albizzias on their boundaries as this timber is still in great demand.

Plucking and Pruning.—The plucking on small-holdings cannot, and will not, improve until the competition amongst the bought leaf factories cease. If factory owners will only consider quantity and not quality, coarse leaf and stalks will continue to come into the factory and result in bad plucking on small-holdings.

The pruning has improved considerably due mainly to the spread of this "Rim-Lung Prune." Going through fields recovering from pruning I have noticed the very small percentage of deaths, which in most cases may be due to disease rather than the after-effects of pruning.

Labour.—There seems to be a general shortage of labour in the village and whatever labour is available is always at a price. This situation has been created, in my opinion, due to the employment of village labour on estates, where full day's wages are paid for a few hours' work.

Weather.—The weather conditions were far from satisfactory. The prolonged drought earlier in the year was followed by floods, which caused considerable loss, when small-holders lost their houses, paddy crops, live-stock, etc.

Blister Blight.—This disease was noticeable on many small-holdings. It was most noticeable on holdings where the tea was under very heavy shade from green manures and interplantations, such as jak, coconut, etc. which are common now on all small-holdings, since the big food drive.

General.—Conditions have improved considerably, restrictions on many essential commodities having been lifted.

Prices paid for green leaf have kept to an average of twenty cents per pound right through the year, giving the small-holders a fair margin of profit.

Finally, I must thank the Headmen and the Chairmen and Members of the Village Committees of Yati-Nuwara for their co-operation in my work.

R. L. ILLANKOON,
Small-Holdings Officer, Gampola.

REPORT

OF

THE SMALL-HOLDINGS OFFICER

BADDEGAMA

FOR 1947

The following extract from the Report of the Commission on Social Services aptly describes the conditions in the working areas :—

“The majority of the people have for long generations been victims of a descending spiral traced by inappropriate food, weakened constitutions, disease, lethargy, ignorance, pessimism, antiquated agriculture and so round and down again.”

Added to this there is the serious dislocation of economic conditions brought about during the war years.

Against such a discouraging background advisory work has by no means been an easy task.

Tea Small-Holdings Competition.—During the year by intensive visiting and demonstrations, small-holders who joined in the Wanduramba Village Committee area competition were urged to complete the progressive works on their holdings.

The progress made at the end of the year showed that it would be possible to carry out the judging early in the new year.

As regards these competitions between holdings no avenues of development were left untouched. In addition some of the competitors have carried out composting and vegetative propagation.

Blister Blight.—This disease was observed in the working areas, on estates as well as on small-holdings. The attacks were relatively light as compared to the damage done at higher elevations. Advice on measures to check the incidence of the disease have been given to owners whose holdings were affected.

Information about the disease was sought by the Chairman, Planters' Association, Galle. At an interview with him the matter was gone into at length. This was followed by an address to the Association by Dr. F. R. Tubbs, the Plant Physiologist.

Progressive Small-holders.—Generally, these small-holders were regular with their field work. This was reflected in the condition of the tea in their holdings. The improvements carried out in connection with previous Tea Small-Holdings Competitions were fairly well maintained.

A first prize winner in one of these competitions had the distinction of being invited to take over a 10-acre block of abandoned tea by its distracted owner, who found it difficult to work it.

With the assistance of the writer equitable working arrangements were arrived at and a start made with improvements. At the moment, both the owner and the lessee are sharing a fair return from the land.

New Plantings.—In nearly every case the poverty of the soil retarded the growth of tea in these new clearings. Owners of these small-holdings were given all necessary advice regarding their management.

Lung Pruning.—The importance of this method of pruning has all along been stressed, but with the advent of Blister Blight it becomes of still greater urgency. In the tea small-holdings competition this method is insisted upon. The average small-holder does not, however, seem to take too kindly to this method. He regards the subsequent removing of lungs as a second pruning operation likely to cost him more money on pruners. So according to his way of reasoning it would be better to clean prune and avoid this additional expense.

Lung removal demonstrations have been directed to convincing him that he could do this minor operation himself.

Plucking.—Owing to the presence of Blister Blight on some small-holdings closer plucking was encouraged during attacks. In the competition areas generally the standard of plucking was satisfactory.

Supplying.—There was more activity regarding the supplying of vacancies. This appears to be due to a more reasonable expectation that the present high prices for tea will last sometime. Contacts were made for small-holders, through this office, to enable them to obtain a reliable type of seed. A maund of this seed cost Rs. 275.

Shade and Green Manures.—Owners of small-holdings affected by Blister Blight, and those close to infected areas, were advised to thin out shade and green manure trees. They were warned against any drastic reduction of the latter.

Vegetative Propagation.—The importance of this method of tea propagation in relation to Blister Blight has been explained to small-holders. In the current competition a few small-holders are carrying out this method successfully. The plants put out by them in the field are doing well.

Fertilisers.—Small-holders who wanted manures were given assistance to obtain permits. The best method and time of application of these manures were carefully explained to them. In some cases visits were paid to these holdings when forking and manuring was in progress.

Composting.—Those small-holders who were taught to make compost on the 3-pit system continue to do so. This compost has supplemented their manure rations. More small-holders would take to composting, but for the fact that sufficient material is difficult to obtain.

Instructional Leaflets.—Started as far back as 1939 these leaflets continue to prove very useful to small-holders. Touching on most aspects of small-holdings development they have proved a real vade mecum to small-holders.

New Factory.—A new factory run by a syndicate of progressive small-holders began manufacturing tea during the year. This factory is centrally situated and as such is a real boon to the small-holders of this area. It has cut down their transport charges appreciably.

The writer had for sometime been trying to persuade small-holders to get together and start such a factory. The war years, however, prevented its materialisation. It is gratifying to find such a factory now an accomplished fact.

Tea Sales.—Early in the year Tea Auctions were resumed. The high prices obtained resulted in small-holders also getting a better price for their green leaf. But with the May strikes, tea sales and business generally became dislocated. Factories were reluctant to pay small-holders for green leaf supplied till their teas were sold. For nearly two months, the plight of small-holders without sufficient financial resources to tide over the period was precarious.

Acknowledgments.—I have once more to convey my sincere thanks to all those Divisional Revenue Officers, Minor Headmen, Village Committees and others interested in small-holdings work, for their co-operation.

F. D. TILLEKERATNE,
Small-Holdings Officer, Baddegama.

The Tea Research Institute of Ceylon

BOARD OF CONTROL

(A) Representing the Planters' Association of Ceylon :—

- (1) Mr. R. C. Scott, C.B.E. (Chairman).
- (2) Mr. H. S. Hurst.
- (3) Mr. W. W. A. Phillips.

(B) Representing the Agency Section, P. A. of Ceylon.

- (4) Mr. J. C. Kelly.
- (5) Mr. F. A. Bond.
- (6) Mr. W. H. Attfield.

(C) Representing the Low-Country Products' Association :—

- (7) Mr. Neil de Alwis.

(D) Representing the Small-Holders :—

- (8) Mr. S. Vytilingam.

(E) Ex-Officio Members :—

- (9) The Hon. the Minister of Finance or his Nominee.
- (10) The Director of Agriculture.
- (11) The Chairman, Planters' Association of Ceylon.
- (12) The Chairman, Agency Section, Planters' Association of Ceylon.

Secretary, Roland V. Norris, D.Sc., St. Coombs, Talawakelle.

